PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70) 09/830015

Applicant's or agent's file reference	FOR FURTHER ACTION	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
4124-14		
International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/IL01/00181	27/02/2001	16/10/2000
International Patent Classification (IPC) or national classification and IPC		
H04N7/10		
Applicant		
XTEND NETWORKS LTD. et al.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 6 sheets, including this cover sheet.

   ☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

   These annexes consist of a total of 8 sheets.

3. This report contains indications relating to the following items:

   - I ☒ Basis of the report
   - II ☐ Priority
   - III ☒ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
   - IV ☐ Lack of unity of invention
   - V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations suporting such statement
   - VI ☐ Certain documents cited
   - VII ☐ Certain defects in the international application
   - VIII ☐ Certain observations on the international application

Date of submission of the demand	Date of completion of this report
09/05/2002	29.01.2003
Name and mailing address of the international preliminary examining authority:	Authorized officer
European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Schindewolf, G Telephone No. +49 89 2399 8953

Form PCT/IPEA/409 (cover sheet) (January 1994)

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/IL01/00181

I. Basis of the report

1. With regard to the **elements** of the international application *(Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17))*:
Description, pages:

1-28 as originally filed

Claims, No.:

1-38 as received on 03/01/2003 with letter of 26/12/2002

Drawings, sheets:

1-22 as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
- ☐ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
- ☐ the claims, Nos.:

☐ the drawings, sheets:

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

III. Non-establishment of opinion with regard to novelty, inventive step and industrial applicability

1. The questions whether the claimed invention appears to be novel, to involve an inventive step (to be non-obvious), or to be industrially applicable have not been examined in respect of:

☐ the entire international application.

☒ claims Nos. 24-38.

because:

☐ the said international application, or the said claims Nos. relate to the following subject matter which does not require an international preliminary examination (*specify*):

☒ the description, claims or drawings (*indicate particular elements below*) or said claims Nos. 24-38 are so unclear that no meaningful opinion could be formed (*specify*):
see separate sheet

☐ the claims, or said claims Nos. are so inadequately supported by the description that no meaningful opinion could be formed.

☐ no international search report has been established for the said claims Nos. .

2. A meaningful international preliminary examination cannot be carried out due to the failure of the nucleotide and/or amino acid sequence listing to comply with the standard provided for in Annex C of the Administrative Instructions:

☐ the written form has not been furnished or does not comply with the standard.

☐ the computer readable form has not been furnished or does not comply with the standard.

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N) Yes: Claims 1-23

	No:	Claims	
Inventive step (IS)	Yes:	Claims	1-23
	No:	Claims	
Industrial applicability (IA)	Yes:	Claims	1-23
	No:	Claims	

2. Citations and explanations
see separate sheet

Re Item III

Non-establishment of opinion with regard to novelty, inventive step and industrial applicability

1. Though the number of independent claims has been somewhat reduced, there remain 5 claims 1,24,27,30 and 33 which have been drafted as separate independent claims. This number of independent claims is considered excessive and unnecessary. It is not considered appropriate in this case to use more than a single independent claim in each category.

   The aforementioned claims therefore lack conciseness. Moreover, lack of clarity of the claims as a whole arises, since the plurality of independent claims makes it difficult, if not impossible, to determine the matter for which protection is sought, and places an undue burden on others seeking to establish the extent of the protection.

   Hence, claims 1,24,27,30 and 33 do not meet the requirements of Article 6 PCT.

2. Contrary to the requirements of Rule 66.8 (a) PCT, the applicant has not indicated the differences between the amended claims and the original claims.

3. Thus in accordance with the provisions set out in the Official Journal of the EPO 11/2001, pages 539-542, paragraph 14, no international preliminary examination is carried out in this case with respect to claims 24-38.

Re Item V

Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Reference is made to the following document:

D1: US-A-5 774 458 (WILLIAMSON LOUIS D) 30 June 1998 (1998-06-30)

2. Nearest prior art, document D1, discloses a system for extending the transmission bandwidth of a communication network, wherein a high end band (900 MHz - 1 GHz) is provided to extend the bandwidth used for the upstream channels, and which comprises a plurality of compensation units for frequency selectively refreshing the respective frequency bands.

   The subject-matter of claim 1 differs from what is disclosed in D1 that it uses an extended frequency band above 1 GHz for additional downstream channels and that a corresponding extension unit connected to the set-top box for tuning the additional downstream channels is provided on the subscriber side.

   This concept which enables expanding the bandwidth capabilities of CATV networks without having to replace the existing infrastructure is not disclosed in or rendered obvious by any of the available prior art documents.

3. Dependent claims 2-23 relate to preferred embodiments of the invention claimed in claim 1.

4. The invention claimed in claims 1-23 is industrially applicable in the field of cable television networks.

CLAIMS

I/we claim:

1. A system for extending the transmission bandwidth of a communication network across an enhanced range of frequencies, the network comprising a head end unit, at least one hub or node connected to the head end unit, a plurality of home outlets connected to the at least one hub or node via cables and a plurality of set top boxes connected each to a home outlet unit, the enhanced range of frequencies comprising a frequency range already in use by the communication network for existing channels and an extended frequency range beyond 1 GHz for additional channels, the system comprising:

a plurality of compensation units distributed at predetermined locations within the network for refreshing and maintaining the characteristics of the extended frequency range to overcome line drop losses associated with the extended frequency range due to network infrastructure topography, each compensation unit comprises a frequency selective circuit for selecting the extended frequency range and an amplifying circuit for amplifying the selected extended frequency range;

an enhanced home outlet unit comprising a frequency conversion filtering circuit for separating the extended frequency range from the frequency range already in use; and

an extension unit connected to a set-top box including a tuner for controlling the additional channels in order to enable the user to interact with the additional channels;

whereby enabling transmission of data at an extended range of frequencies and at substantially higher data rates.

2. The system of claim 1 wherein the communication network is a cable television system utilizing a plurality of transmission channels and distributing audio, video, text, analog, and digital information.

3. The system according to claims 1 wherein the extended frequency range comprises frequencies between about 1 GHz to about 3 GHz.

4. The system of claim 1 wherein the extended frequency range comprises upstream and downstream channels.

5. The system of claim 1 further comprising an upgrade hub or node module connected to the hub or node for adding gain and slope to losses to the extended frequency range.

6. The system of claim 5 wherein the upgrade hub or node module further comprises a data communication unit, the data communication unit comprises a duplex receiver or transmitter for communicating data across the extended frequency range.

7. The system of claim 6 wherein the data communication unit comprises:

a receiver-transmitter for receiving data from a data communication network and for transmitting data to the data communication network;

a demodulator-modulator for encoding the data; and

a data router for directing the data to the data communication network and for directing the data to a central processing unit for processing.

8. The system of claim 6 wherein the upgrade hub or node module further comprises a multiplexer for combing a signal generated by the head end with data transmitted from the data communication unit.

9. The system of claim 1 further comprising an enhanced cable connector assembly comprising a coaxial adapter fitted to a standard cable connector for allowing the transmission of a signal modulated across the extended frequency range.

10. The system of claim 1 wherein each compensation unit further comprises a filter for separating between at least one upstream and downstream channel.

11. The system of claim 1 wherein the compensation frequency selective circuit is a single stage multiplexer for separating the enhanced range of frequency to the

frequency range already in use, an extended downstream frequency range and an extended upstream frequency range.

12. The system according to claim 1 wherein the amplifying circuit of the compensation unit comprises a downstream signal amplifier and an upstream signal amplifier for handling gain and slop noise factors decayed in transmission coaxial lines.

13. The system of claim 1 wherein the compensation unit further comprises:

an input connection for receiving a downstream signal and for transmitting an upstream signal;

an equalizer circuit coupled to an output connection of the frequency selective circuit for attenuating lower frequencies of downstream and upstream signals; and

at least one output connection for providing the downstream signal after being processed by the frequency selective circuit, the equalizer circuit, and the amplifying circuit, and for receiving the upstream signal.

14. The system of claim 13 wherein the compensation unit amplifying circuit is coupled to the output connection of the equalizer circuit for the amplification of the downstream signal and the upstream signal.

15. The system of claim 13 wherein the compensation unit further comprises a communication network line distribution unit coupled to the output connection of the compensation unit for receiving the downstream signal, the line distribution unit having an output connection for providing the downstream signal and the upstream signal.

16. The system of claim 1 further comprising an enhanced home splitter unit, the enhanced home splitter unit comprises a band divider for splitting the enhanced frequency range to the extended frequency range and the frequency range already in use and an amplifier for compensating for the losses in the extended frequency range.

17. The system of claim 1 wherein the compensation unit is connected to the communication network as a standalone unit.

18. The system of claim 1 wherein the compensation unit supports two-way symmetrical transmission of signals in the extended frequency range.

19. The system of claim 1 wherein the compensation unit supports two-way asymmetrical transmission of signals in the extended frequency range.

20. The system of claim 5 wherein the upgrade hub or node module is connected to the communication network as a symmetrical device to support two-way symmetrical transmission of signals in the extended frequency range.

21. The system of claim 5 wherein the upgrade hub or node module is connected to the communication network as an asymmetrical device to support two-way asymmetrical transmission of signals in the extended frequency range.

22. The system of claim 16 wherein the enhanced home splitter unit supports two-way symmetrical transmission of signals in the frequency range already in use and the extended frequency range.

23. The system of claim 16 wherein the enhanced home splitter unit supports two-way asymmetrical transmission of signals in the frequency range already in use and the extended frequency range.

24. An extension unit to a set-top box comprising the elements of:

a tuner for controlling broadcast channels within an extended frequency range;

a switch for enabling the selection of at least one mode of operation; and

a filter for separating the extended frequency range to an downstream and upstream pass regions; and

a modem for encoding information and transmitting the information to a user; and for decoding the information received from the user and transmitting the information upstream to a transmission center.

25. The extension unit to the set-box according to claim 24 wherein the extension unit to the set-top box is connected to a communication network as a symmetrical device to support two-way symmetrical transmission of signals in the extended frequency range.

26. The extension unit to the set-top box according to claim 24 wherein the extension unit to the set-top box is connected to a communication network as an asymmetrical unit to support two-way asymmetrical transmission of signals in the extended frequency range.

27. A compensation unit dividing and amplifying a signal comprising:

a frequency band divider circuit for separating at least two signal streams for selective processing;

a downstream signal amplifying circuit for amplifying a signal representative of information units transmitted by a transmission center to users; and

an upstream signal amplifying circuit for amplifying a signal representative of information sent by users to an transmission center;

an input connection for receiving a downstream signal and for transmitting an upstream signal;

at least one frequency selective circuit coupled to the input connection for separating a least two signal streams;

an equalizer circuit coupled to an output connection of the frequency selective circuit for attenuating lower frequencies of the downstream and upstream signal; and

at least one output connection providing the downstream signal after being processed by the frequency selective circuit, the equalizer circuit, and the downstream and upstream amplifying circuits, and for receiving the upstream signal.

28. The compensation unit of claim 27 further comprising an amplifier circuit coupled to an output connection of the equalizer circuit for the amplification of the downstream signal and the upstream signal.

29. The compensation unit of claim 28 further comprising a communication network line distribution unit coupled to the output connection of the compensation unit for receiving the downstream signal, the line distribution unit having an output connection for providing the downstream signal and the upstream signal.

30. In a communication network utilizing a communication media infrastructure for the transmission of a broadband signal representative of information units received from and sent to external information sources, the information units encoded into modulated electronic signals, the signals multiplexed into the broadband electronic signal, from a transmission center via diverse electronic components operative in the preservation of the transmitted signal to a plurality of users and from the plurality of users via the communication media via the diverse electronic components operative in maintaining the functional characteristics of the transmitted broadband signal to the transmission center, a method for sending information across an extended frequency range, the extended frequency range comprises frequencies beyond 1 GHz, the method comprising:

combining signals representative of the information received from information sources into a combined broadband signal modulated across an extended frequency range;

superimposing signals representative of information units received from additional information sources onto the broadband signal; and

modulating and transmitting the combined broadband signal across the extended frequency range to a plurality of users or to a transmission center;

amplifying the broadband signal for compensating for line drop losses due to network infrastructure topography;

adding gain and slope to the broadband signal for compensating for signal loss;

filtering the broadband signal for dividing the broadband signal according to predefined frequency regions and according to predefined parameters relating to signal content type and direction of the broadband signal; and

tuning the divided signal for controlling the said division of the divided signal into predefined frequency regions;

whereby utilizing a standard transmission medium previously operating in a significantly narrower bandwidth for transmission in the extended frequency range.

31. The method of claim 30 wherein the extended frequency range comprises frequencies between about 1 GHz to about 3Ghz.

32. The method of claim 30 wherein the communication network is a cable television system carrying video, audio and data information units and any combination thereof to a plurality of users utilizing a plurality of transmission channels.

33. A two-way multi-user transmission and communication system having the capability of utilizing an expanded range of frequencies in order to transmit an increased quantity of information units encoded into electronic signals and inserted into a transmittable broadband signal without affecting the simultaneous transmission of existing transmittable information to a plurality of users, the system comprising:

a compensation unit including at least one downstream and upstream amplifying units for amplifying the broadband signal;

a home outlet splitter unit including a signal divider for distributing a split broadband signal modulated in an extended frequency range beyond 1 GHz;

a home outlet unit including at least one filter for separating the broadband signal into predefined range of frequencies and for manipulating the broadband signal predefined range of frequencies; and

an extension unit to a set-top box for interfacing with a terminal or any other communication device comprising at least one tuner for controlling additional channels within the extended frequency range , at least one filter for separating the predefined range of frequencies, at least one modulator, and at least one demodulator for decoding the broadband signal in order the enable a user to interact with channels or elements of the broadband signal and for encoding information generated by the user or by the set-top box into an upstream region of the broadband signal.

34. The system of claim 33 further comprising an enhanced cable connector, the cable connector comprises a coaxial adapter fitted to a standard cable connector for allowing the transmission of downstream and upstream transmission of broadband signals across the extended frequency range.

35. The system of claim 33 further comprising a data communication unit, the data communication unit comprising at least one data router, at least one modulator, at least one demodulator and a central processing unit for receiving or transmitting broadband signals across the extended frequency range.

36. The system of claim 33 further comprising an upgrade hub module, the upgrade hub module comprising at least one amplifier for compensating for loss of signal, and at least one multiplexer for superimposing additional signals into the broadband signal across the extended frequency range.

37. The system of claim 33 wherein the extended frequency range is between about 1000 and about 3000 Mhz.

38. The system of claim 37 wherein in symmetrical operation mode the extended frequency range of frequencies range of about 1000-3000 Mhz is divided into a downstream and an upstream band each having a range of about 1000 Mhz.

From the INTERNATIONAL BUREAU

PCT

NOTIFICATION OF ELECTION

(PCT Rule 61.2)

To:

Commissioner
US Department of Commerce
United States Patent and Trademark Office, PCT
2011 South Clark Place Room CP2/5C24
Arlington, VA 22202
ETATS-UNIS D'AMERIQUE

in its capacity as elected Office

Date of mailing (day/month/year) 08 July 2002 (08.07.02)	
International application No. PCT/IL01/00181	**Applicant's or agent's file reference** 4124-14
International filing date (day/month/year) 27 February 2001 (27.02.01)	**Priority date** (day/month/year) 16 October 2000 (16.10.00)
Applicant WEINSTEIN, Hillel et al	

1. The designated Office is hereby notified of its election made:

[X] in the demand filed with the International Preliminary Examining Authority on:

09 May 2002 (09.05.02)

[ ] in a notice effecting later election filed with the International Bureau on:

2. The election [X] was

[ ] was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

The International Bureau of WIPO **34, chemin des Colombettes** **1211 Geneva 20, Switzerland**	Authorized officer Olivia TEFY
Facsimile No.: (41-22) 740.14.35	Telephone No.: (41-22) 338.83.38

PATENT COOPERATION TREATY

From the INTERNATIONAL BUREAU

PCT

NOTIFICATION OF RECEIPT OF RECORD COPY

(PCT Rule 24.2(a))

To:

AGMON, Jonathan
Soroker - Agmon, Law Offices
12th floor
Levinstein Tower
Petach Tikva Road 23
66184 Tel Aviv
ISRAËL

Date of mailing (day/month/year)	IMPORTANT NOTIFICATION
26 March 2001 (26.03.01)	
Applicant's or agent's file reference	**International application No.**
4124-14	PCT/IL01/00181

The applicant is hereby notified that the International Bureau has received the record copy of the international application as detailed below.

Name(s) of the applicant(s) and State(s) for which they are applicants:

XTEND NETWORKS LTD. (for all designated States except US)
WEINSTEIN, Hillel et al (for US)

International filing date	:	27 February 2001 (27.02.01)
Priority date(s) claimed	:	16 October 2000 (16.10.00)
Date of receipt of the record copy by the International Bureau	:	14 March 2001 (14.03.01)
List of designated Offices	:	

AP :GH,GM,KE,LS,MW,MZ,SD,SL,SZ,TZ,UG,ZW
EA :AM,AZ,BY,KG,KZ,MD,RU,TJ,TM
EP :AT,BE,CH,CY,DE,DK,ES,FI,FR,GB,GR,IE,IT,LU,MC,NL,PT,SE,TR
OA :BF,BJ,CF,CG,CI,CM,GA,GN,GW,ML,MR,NE,SN,TD,TG
National :AE,AG,AL,AM,AT,AU,AZ,BA,BB,BG,BR,BY,BZ,CA,CH,CN,CR,CU,CZ,DE,DK,DM,DZ,EE,ES,FI,GB,GD,GE,GH,GM,HR,HU,ID,IL,IN,IS,JP,KE,KG,KP,KR,KZ,LC,LK,LR,LS,LT,LU,LV,MA,MD,MG,MK,MN,MW,MX,MZ,NO,NZ,PL,PT,RO,RU,SD,SE,SG,SI,SK,SL,TJ,TM,TR,TT,TZ,UA,UG,US,UZ,VN,YU,ZA,ZW

ATTENTION

The applicant should carefully check the data appearing in this Notification. In case of any discrepancy between these data and the indications in the international application, the applicant should immediately inform the International Bureau.

In addition, the applicant's attention is drawn to the information contained in the Annex, relating to:

- [X] time limits for entry into the national phase
- [ ] confirmation of precautionary designations
- [X] requirements regarding priority documents

A copy of this Notification is being sent to the receiving Office and to the International Searching Authority.

The International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland

Facsimile No. (41-22) 740.14.35

Authorized officer:

Jean-Marie McAdams

Telephone No. (41-22) 338.83.38

09836015

PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference	FOR FURTHER ACTION	see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.
4124-14		
International application No.	International filing date *(day/month/year)*	(Earliest) Priority Date *(day/month/year)*
PCT/IL 01/00181	27/02/2001	16/10/2000
Applicant		
XTEND NETWORKS LTD. et al.		

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 2 sheets.

[X] It is also accompanied by a copy of each prior art document cited in this report.

1. **Basis of the report**

a. With regard to the **language**, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

[ ] the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).

b. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international search was carried out on the basis of the sequence listing :

[ ] contained in the international application in written form.

[ ] filed together with the international application in computer readable form.

[ ] furnished subsequently to this Authority in written form.

[ ] furnished subsequently to this Authority in computer readble form.

[ ] the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

[ ] the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

2. [ ] **Certain claims were found unsearchable** (See Box I).

3. [ ] **Unity of invention is lacking** (see Box II).

4. With regard to the **title,**

[X] the text is approved as submitted by the applicant.

[ ] the text has been established by this Authority to read as follows:

5. With regard to the **abstract,**

[X] the text is approved as submitted by the applicant.

[ ] the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the **drawings** to be published with the abstract is Figure No. 2

[X] as suggested by the applicant.

[ ] None of the figures.

[ ] because the applicant failed to suggest a figure.

[ ] because this figure better characterizes the invention.

INTERNATIONAL SEARCH REPORT

International Application No
PCT/IL 01/00181

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H04N7/10 H04N7/173

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 H04N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 774 458 A (WILLIAMSON LOUIS D) 30 June 1998 (1998-06-30)	1,2,4,5, 13-16, 18,20, 32, 37-41,46
Y	column 1, line 36 - line 65; figure 6	6,7,33, 34
A		28,36,47

Y	US 4 970 722 A (PRESCHUTTI JOSEPH P) 13 November 1990 (1990-11-13)	6,7,33, 34
A	column 7, line 4 - line 49; figure 2	1,32

A	US 5 963 844 A (DAIL JAMES E) 5 October 1999 (1999-10-05) the whole document	1,28,32, 36-39,47

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
4 October 2001	11/10/2001

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Beaudoin, O

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/IL 01/00181

Patent document cited in search report		Publication date	Patent family member(s)		Publication date
US 5774458	A	30-06-1998	NONE		
US 4970722	A	13-11-1990	CA	1300239 A1	05-05-1992
			EP	0339078 A1	02-11-1989
			JP	2502061 T	05-07-1990
			WO	8904567 A1	18-05-1989
			US	4947386 A	07-08-1990
US 5963844	A	05-10-1999	CA	2205248 A1	18-03-1998

HOME COPY

4124-14

PCT REQUEST

Original (for SUBMISSION) - printed on 27.02.2001 01:47:58 PM

0	For receiving Office use only	
0-1	International Application No.	PCT/IL 01 / 00181
0-2	International Filing Date	27 FEB 2001 (27.02.01)
0-3	Name of receiving Office and "PCT International Application"	ISRAEL PATENT OFFICE PCT International Application
0-4	Form - PCT/RO/101 PCT Request	
0-4-1	Prepared using	PCT-EASY .Version 2.91 (updated 01.01.2001)
0-5	Petition The undersigned requests that the present international application be processed according to the Patent Cooperation Treaty	
0-6	Receiving Office (specified by the applicant)	Israel Patent Office (RO/IL)
0-7	Applicant's or agent's file reference	4124-14
I	Title of invention	SYSTEM AND METHOD FOR EXPANDING THE OPERATIONAL BANDWIDTH OF A COMMUNICATION SYSTEM
II	Applicant	
II-1	This person is:	applicant only
II-2	Applicant for	all designated States except US
II-4	Name	XTEND NETWORKS LTD.
II-5	Address:	XTEND NETWORKS Gibor House, 6 Koifman Street 68012 Tel Aviv Israel
II-6	State of nationality	IL
II-7	State of residence	IL
III-1	Applicant and/or inventor	
III-1-1	This person is:	applicant and inventor
III-1-2	Applicant for	US only
III-1-4	Name (LAST, First)	WEINSTEIN, Hillel
III-1-5	Address:	3 Tel Mane Street 34363 Haifa Israel
III-1-6	State of nationality	IL
III-1-7	State of residence	IL

1 RO

4124-14

PCT REQUEST

Original (for SUBMISSION) - printed on 27

0	For receiving Office use only	
0-1	International Application No.	
0-2	International Filing Date	
0-3	Name of receiving Office and "PCT International Application"	
0-4	Form - PCT/RO/101 PCT Request	
0-4-1	Prepared using	PCT-EASY Version 2.91 (updated 01.01.2001)
0-5	Petition The undersigned requests that the present international application be processed according to the Patent Cooperation Treaty	
0-6	Receiving Office (specified by the applicant)	Israel Patent Office (RO/IL)
0-7	Applicant's or agent's file reference	4124-14
I	Title of invention	SYSTEM AND METHOD FOR EXPANDING THE OPERATIONAL BANDWIDTH OF A COMMUNICATION SYSTEM
II	Applicant	
II-1	This person is:	applicant only
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II-7	State of residence	IL
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III-1-7	State of residence	IL

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III-2	**Applicant and/or inventor**	
III-2-1	This person is:	applicant and inventor
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III-2-6	State of nationality	IL
III-2-7	State of residence	IL
IV-1	**Agent or common representative; or address for correspondence** The person identified below is hereby/has been appointed to act on behalf of the applicant(s) before the competent International Authorities as:	agent
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V	**Designation of States**	
V-1	Regional Patent (other kinds of protection or treatment, if any, are specified between parentheses after the designation(s) concerned)	AP: GH GM KE LS MW MZ SD SL SZ TZ UG ZW and any other State which is a Contracting State of the Harare Protocol and of the PCT EA: AM AZ BY KG KZ MD RU TJ TM and any other State which is a Contracting State of the Eurasian Patent Convention and of the PCT EP: AT BE CH&LI CY DE DK ES FI FR GB GR IE IT LU MC NL PT SE TR and any other State which is a Contracting State of the European Patent Convention and of the PCT OA: BF BJ CF CG CI CM GA GN GW ML MR NE SN TD TG and any other State which is a member State of OAPI and a Contracting State of the PCT
V-2	National Patent (other kinds of protection or treatment, if any, are specified between parentheses after the designation(s) concerned)	AE AG AL AM AT AU AZ BA BB BG BR BY BZ CA CH&LI CN CR CU CZ DE DK DM DZ EE ES FI GB GD GE GH GM HR HU ID IL IN IS JP KE KG KP KR KZ LC LK LR LS LT LU LV MA MD MG MK MN MW MX MZ NO NZ PL PT RO RU SD SE SG SI SK SL TJ TM TR TT TZ UA UG US UZ VN YU ZA ZW
V-5	**Precautionary Designation Statement** In addition to the designations made under items V-1, V-2 and V-3, the applicant also makes under Rule 4.9(b) all designations which would be permitted under the PCT except any designation(s) of the State(s) indicated under item V-6 below. The applicant declares that those additional designations are subject to confirmation and that any designation which is not confirmed before the expiration of 15 months from the priority date is to be regarded as withdrawn by the applicant at the expiration of that time limit.	
V-6	**Exclusion(s) from precautionary designations**	NONE
VI-1	**Priority claim of earlier international application**	
VI-1-1	Filing date	16 October 2000 (16.10.2000)
VI-1-2	Number	PCT/IL00/00655
VI-1-3	PCT receiving Office	IL
VI-2	**Priority document request** The receiving Office is requested to prepare and transmit to the International Bureau a certified copy of the earlier application(s) identified above as item(s):	VI-1

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VII-1	International Searching Authority Chosen	European Patent Office (EPO) (ISA/EP)	
VIII	Check list	number of sheets	electronic file(s) attached
VIII-1	Request	4	-
VIII-2	Description	28	-
VIII-3	Claims	11	-
VIII-4	Abstract	1	EZARST00.TXT
VIII-5	Drawings	22	-
VIII-7	TOTAL	66	
	Accompanying items	paper document(s) attached	electronic file(s) attached
VIII-8	Fee calculation sheet	✓	-
VIII-10	Copy of general power of attorney	reference no. <no.>	-
VIII-16	PCT-EASY diskette	-	diskette
VIII-18	Figure of the drawings which should accompany the abstract	2	
VIII-19	Language of filing of the international application	English	
IX-1	Signature of applicant or agent		
IX-1-1	Name (LAST, First)	AGMON, Jonathan	

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10-1	Date of actual receipt of the purported international application	
10-2	Drawings:	
10-2-1	Received	
10-2-2	Not received	
10-3	Corrected date of actual receipt due to later but timely received papers or drawings completing the purported international application	
10-4	Date of timely receipt of the required corrections under PCT Article 11(2)	
10-5	International Searching Authority	ISA/EP
10-6	Transmittal of search copy delayed until search fee is paid	

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11-1	Date of receipt of the record copy by the International Bureau	

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PCT (ANNEX FEE CALCULATION SHEET)

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(This sheet is not part of and does not count as a sheet of the international application)

	For receiving Office use only:				
0-1	International Application No.				
0-2	Date stamp of the receiving Office				
0-4	Form - PCT/RO/101 (Annex) PCT Fee Calculation Sheet				
0-4-1	Prepared using		PCT-EASY Version 2.91 (updated 01.01.2001)		
0-9	Applicant's or agent's file reference		4124-14		
2.	Applicant		XTEND NETWORKS LTD., et al.		
12	Calculation of prescribed fees		fee amount/multiplier	total amounts (USD)	total amounts (ILS)
12-1	Transmittal fee	T	⇨		437
12-2	Search fee	S	⇨	846	
12-3	International fee				
	Basic fee				
	(first 30 sheets)	b1	302 USD		
12-4	Remaining sheets		36		
12-5	Additional amount	(X)	9 USD		
12-6	Total additional amount	b2	324 USD		
12-7	b1 + b2 =	B	706 USD		
12-8	Designation fees				
	Number of designations contained in international application		87		
12-9	Number of designation fees payable (maximum 6)		6		
12-10	Amount of designation fee	(X)	82 USD		
12-11	Total designation fees	D	492 USD		
12-12	PCT-EASY fee reduction	R	-117 USD		
12-13	Total international fee (B+D-R)	I	⇨	1,081	
12-14	Fee for priority document				
	Number of priority documents requested		1		
12-15	Fee per document	(X)	0 ILS		
12-16	Total priority document fee	P	⇨		0
12-17	TOTAL FEES PAYABLE (T+S+I+P)		⇨	1,927	437
12-18	Mode of payment		other		

VALIDATION LOG AND REMARKS

13-2-3	Validation messages Names	Green? Applicant 1.:Telephone No. missing
		Green? Applicant 1.:Facsimile No. missing
13-2-10	Validation messages For receiving Office/International Bureau use only	Green? Verify electronic data for consistency against printed form.

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PCT-EASY INFORMATION SHEET

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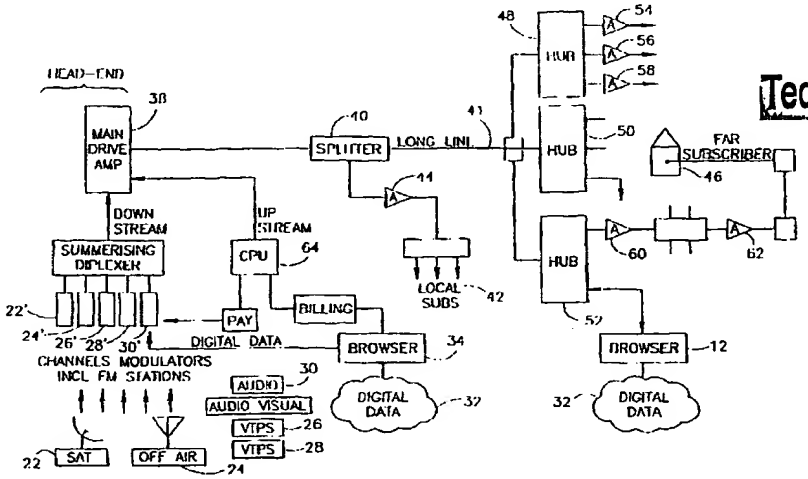

(57) Abstract: A transmission network system includes a head end for generating a downstream signal having a substantially expanded range of frequencies, a communication medium, such as a fiber optic cable and coaxial cable coupled to the head end section for routing the signal through the transmission network to a plurality of subscribers, and compensation units coupled to operative components of the system for receiving the transmitted signals, selectively amplify and attenuate the signal levels within the substantially expanded range frequencies, and forwarding the signals to the subscribers. The system is enhanced to have improved information-carrying capabilities by the utilization of a broadband signal by the modulation of the signal across a substantially expanded range of frequencies and by the transmission of the signal via a series of operative network particles selectively modified or added to the cable plant in order to provide suitable processing of the signal elements spread over the entire spectrum of the substantially expanded frequency range.

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SYSTEM, APPARATUS AND METHOD FOR EXPANDING THE OPERATIONAL BANDWIDTH OF A COMMUNICATION SYSTEM

BACKGROUND OF THE INVENTION

FIELD OF THE INVENTION

The present invention generally relates to a system and method of improving the information transfer capabilities of a communication system. More particularly, the present invention relates to a system, apparatus and method for substantially expanding the range of frequencies utilizable by a cable television network for broadband signal transmission.

DISCUSSION OF THE RELATED ART

Cable television (CATV) is a form of broadcasting that transmits programs to paying subscribers via a physical land-based infrastructure of coaxial cables or via a combination of fiber-optic and coaxial cables rather than through the airwaves. Thus CATV networks provide a direct link from a transmission center, such as a head-end, to a plurality of subscribers located at typically addressable remote locations, such as homes and businesses. The CATV networks utilize a signal distribution service transmitting FM radio broadcasts, multi-channel TV programs, Pay-Per-Movie (Video on Demand), information services such as videotext, and the like. In recent years novel services were made available to the subscribers. Such services include interactive services. One such service regards a two-way, interactive communication involving access to established data communication networks, such as the Internet.

A CATV system comprises a plurality of elements, which are operative in maintaining the flow of electrical data information through a coaxial conductor or through a combination of fiber-optic and coaxial cables to subscribers. The infrastructure of the system is required to span vast urban areas by cables installed underground or on high poles in order to be distributed to the subscribers. It is routinely expected that the transmitted signals be kept at their highest possible fidelity having the lowest possible random energy interference level.

A CATV head-end is the central transmission center operative to gather gathering and to provide complex audio, visual, and data media. At the head-end external signals such as satellite, microwave, and local TV station broadcasts are

received from the various types of employed antennas. Additionally, locally produced and pre-recorded programs can be introduced into the system. The head-end responsibility is to process and to combine the received signals. In addition, the head-end assigns a channel frequency to all the signals destined for cable distribution. The programs relayed multiplexed into mapped channels, which are then offered to the subscribers selectively or are bundled as packages. Pay-per-View and special pay channels are added by keying the subscribers' set-top boxes or by phone authorization from the subscribers. If an upstream channel is operative in the network the option of electrical authorization can be provided to the subscribers.

A plurality of trunk cables, constructed of large diameter coaxial cables or of a combination of coaxial and fiber-optic cables, carry the signals from the head-end to a series of distribution points. Such distribution points are hub stations. Trunk cables share the same properties, as do generic transmission lines with regard to signal attenuation. Therefore, in order to maintain adequate signal strength over long distances, amplifiers are required at regular intervals. Feeder cables branch out from the trunks and are responsible for serving local neighborhoods. Feeder cables are tapped at recurrent locations to furnish the familiar coaxial drop cables that enter directly into the CATV subscriber's premises. Terminal equipment is connected to the drop cable inside a CATV subscriber's home via a wall outlet. Among the more common terminal devices are televisions, VCRs, set-top boxes, converters, de-scramblers, cable modems, and splitters.

The rigid standards under which the CATV systems are designed, engineered, and built, presently allow the overall spectral band width utilized for the transmission of signals to reach only about 750 MHz with about 1 GHz as the foreseeable future limit. Current CATV systems use the 5-35 MHz frequency band for reverse channel communication and the 100-750 MHz frequency band is used for the forward channel. The bandwidth is substantially limited by the conventional design of the components constituting the distribution plant.

The recent advent of two-way digital data services such as the Internet supported by the addition of data network browsers embedded into data network server systems interfacing into the CATV head-ends or into the CATV hub stations requires significantly high two-way bandwidth to enable the efficient transfer of data services. To enable the provision of two-way data services within the current 5-750MHz band

spectrum spaces for the forward (downstream) transmission of the digital information have to be cleared and reserved for Internet data while return digital communication is relayed on a specifically allocated upstream path. Alternatively separate telephone communication lines are utilized for the subscriber. In order to integrate the two-way transmission of the added digital information within the existing usable bandwidth, all current CATV systems have in common a single small return path for upstream transmission allocated to the 5-35 MHz range. For the forward data path the possibilities are substantially limited. One option is to free currently active channels within the allocated 35-450, 35-550, 35-650, or 35-750 MHz downstream bandwidth for the downstream transmission. Another option is the multiplexing of forward data paths into the currently active channels within the allocated 35-450, 35-550, 35-650, or 35-750 MHz downstream bandwidth. The main problem concerning the existing options regarding the increase of the quantity of transmitted information is that the current requirements for the quantity of the transmitted information are substantially higher than the potential increase provided by the above mentioned options.

Thus in order to accomplish the integration of the two-way data information services involving interactive communications into the existing CATV systems, the signal transfer capabilities of the cable networks must be substantially enhanced. The needs and requirements for faster two-way data transfer bring into focus the bandwidth constraint problem. This problem relates to the limitation regarding the range of the useable frequencies that are available for signal transmission. Due to various problems related to the design, the engineering, and the manufacturing of the components constituting the current cable plant infrastructure prior solutions do not allow transmission in the frequencies above 750MHz. Therefore, there is a need to improve the performance of the CATV system by expanding the bandwidth capabilities of a conventional CATV system without having to replace the existing coaxial cable infrastructure.

The object of the present invention is to introduce a system, apparatus and method for expanding the operational bandwidth of a CATV system, for both the forward data signal path from the data network servers to the CATV subscriber and the reverse data path signal path. The present invention makes available a multiple Gbps symmetrical or asymmetrical service to subscribers of a cable communication network.

SUMMARY OF THE PRESENT INVENTION

One aspect of the present invention regards a system for extending the transmission path across a range of frequencies. The system contains a compensation unit for dividing and amplifying a signal, a home outlet splitter unit for dividing, amplifying and splitting a signal, a home outlet unit for expanding bandwidth and filtering frequencies, an extension unit to a set top box, and an enhanced cable connector assembly for transmitting a signal. The system thereby enables the transmission of data at substantially higher data rates.

The second aspect of the present invention regards an extension unit to a set-top box which includes tuner means for controlling the additional channels within the extended range of frequencies, switching means to enable selection of mode of operation, filtering means to separate the appended extended range of frequencies to downstream and upstream regions, modem means to encode the information and transmit data to the subscriber, and modem means to decode the information received from the subscriber and transmit the information upstream to the hub station unit.

The third aspect of the present invention regards a compensation unit for the division and amplification of a signal. The compensation unit includes a frequency band divider means to separate at least two signal streams for selective processing, a downstream signal amplifying means for amplifying a signal representative of information units transmitted by a transmission center to users, and an upstream signal amplifying means for amplifying a signal representative of information sent by users to a transmission center.

The fourth aspect of the present invention regards a hub station unit for adding gain and slope to losses of the signal transmitted and for combining the signal

transmitted by a transmission center with a signal transmitted by a data communication unit. The hub station includes means for adding gain and slope to losses of the signal transmitted in the downstream direction from a transmission center to the users, means for adding gain and slope to losses of the signal transmitted in the upstream direction from the users to the transmission center, and multiplexer means to combine the signal transmitted by a transmission center with the signal transmitted by a data communication unit.

The fifth aspect of the present invention regards a home splitter unit for splitting and amplifying a signal. The home splitter unit includes divider means to split the signal modulated across the extended range of frequencies to a varied number of users, and amplifier means to compensate for the losses in the signal due to line characteristics.

The sixth aspect of the present invention regards a home outlet unit for expanding bandwidth and filtering frequencies, the home outlet unit includes bandwidth expanding means to add to the standard usable bandwidth an extended range of frequencies, and filtering means to separate the appended extended range of frequencies to downstream and upstream pass regions.

The seventh aspect of the present invention regards a communication network utilizing a communication media infrastructure for the transmission of a broadband signal representative of information units received from and sent to external information sources. The information units are encoded into modulated electronic signals. The signals are multiplexed into a broadband electronic signal and sent from a transmission center via diverse electronic components operative in the preservation of the transmitted signal's vital characteristics to a plurality of users and from the plurality

of users via the transmission media via the diverse electronic components operative in maintaining the functional characteristics of the transmitted signal to the transmission center. The communication network contains a method for utilizing an expanded transmission path operative across a substantially increased range of frequencies. The method includes combining the signals representative of the information received from information sources/users into a combined broadband signal modulated across a substantially expanded bandwidth, superimposing signals representative of information units received from additional information sources connected at various locations to the transmission path onto the broadband signal modulated across the substantially expanded bandwidth, transmitting the combined broadband signal modulated across a substantially expanded bandwidth to a plurality of users/transmission center, and maintaining the functional characteristics of the broadband signal modulated across a substantially expanded bandwidth during a series of processing activities performed by a set of components operatively participating in the expanded bandwidth transmission process whereby utilizing the standard transmission medium previously operating in a significantly narrower bandwidth for transmission in a substantially expanded bandwidth.

The eighth aspect of the present invention regards a two-way multi-user transmission and communication system having the capability of utilizing a substantially expanded range of frequencies in order to transmit a significantly increased quantity of information units encoded into electronic signals and inserted into a transmittable broadband signal at frequency-related locations the broadband signal having prior transmittable information multiplexed therein without affecting the simultaneous transmission of the existing transmittable information to a plurality of users in response

to the users' corresponding demands. The system includes a compensation unit including downstream and upstream amplifying units in order to amplify the broadband signal, a home outlet splitter unit including a signal divider to distribute the split broadband signal modulated across a substantially expanded range of frequencies among a predefined group of users, a home outlet unit including filtering components having the capability of handling an expanded range of frequencies in order to separate the broadband signal into predefined range of and to suitable manipulate the broadband signal elements inserted into the significantly expanded bandwidth region, and an extension unit to a set-top box interfacing with a terminal or any other communication device including tuner components to control the additional channels combined within the expanded region of the frequency bandwidth, filtering components to separate the diverse frequency regions, modulators, and demodulators to decode the signal in order the enable the user to interact with the various elements of the signal and to encode the information resulted from the users request into the upstream region of the broadband signal, and an enhanced cable connector assembly to provide for the downstream and upstream transmission of the signals having the proper spectral response characteristics.

Each of the above embodiments of the present invention contributes to an enhanced transmission of information units within a transmission and communication system in the about 1GHz to the about 3GHz frequency range.

Each of the above embodiments of the present invention provides for the utilization of a substantially expanded transmission bandwidth for the transmission of information having diverse content such as video, audio and data.

Each of the above embodiments of the present invention provides for substantially improving the data transmission rates within a transmission and communication system.

BRIEF DESCRIPTION OF THE DRAWINGS

The novel features of the present invention are set forth in the appended claims. The invention itself, as well as a preferred mode of usage will be best understood by reference to the following detailed description of an illustrative embodiment when read in conjunction with the accompanying drawings, wherein:

Figs. 1A is a graphical representation of the spectral response of the standard CATV system; and

Fig. 1B is a graphical representation of the spectral response of the Extended Bandwidth Cable System (XBCS), in accordance with a preferred embodiment of the present invention; and

Fig. 2 is a block diagram of a standard CATV system; and

Fig. 3 is a schematic illustration of a standard CATV subscriber home outlet; and

Fig. 4 is a schematic illustration of an XBCS CATV subscriber home outlet in accordance with a preferred embodiment of the present invention; and

Fig. 5 illustrates the electrical circuitry of a XBCS CATV subscriber home outlet, in accordance with a preferred embodiment of the present invention; and

Fig. 6 is a schematic illustration of the XBCS set-top unit, in accordance with preferred embodiment of the present invention; and

Fig. 7 is a schematic illustration of the symmetrical XBCS set-top unit, in accordance with a preferred embodiment of the present invention; and

Fig. 8 is a schematic view of the XCBS CATV subscriber home outlet splitter, in accordance with a preferred embodiment of the present invention; and

Figs 9A, 9B, 9C are schematic views of a XBCS splitter nearest to the subscriber home outlet including the symmetrical added units, in accordance with a preferred embodiment of the present invention; and

Fig. 10 is a graphical representation of the mechanical connections to a typical CATV hub; and

Fig. 11 is a diagram showing the mechanical introduction of a proposed hub modification into the XBCS hub, in accordance with a preferred embodiment of the present invention; and

Fig.12 is a combined schematic block diagram and a general view illustrating the new hub module of the XBCS system, in accordance with a preferred embodiment of the present invention; and

Fig.13 is a schematic block diagram of the new asymmetrical hub module circuitry of the XBCS system, in accordance with a preferred embodiment of the present invention;

Fig.14 is a general view illustrating the mechanical introduction of a new symmetrical hub module into a typical CATV hub, in accordance with a preferred embodiment of the present invention; and

Fig. 15 is a combined schematic block diagram showing the new symmetrical hub circuitry of the XBCS system, in accordance with a preferred embodiment of the present invention; and

Fig. 16 is a schematic block diagram showing the proposed compensation unit of the XBCS system, in accordance with a preferred embodiment of the present invention; and

Fig. 17 is a graphical representation of the introduction of the proposed compensation unit as a standalone signal booster into the CATV system, in accordance with a preferred embodiment of the present invention; and

Fig. 18 is a schematic block diagram of the XBCS compensation circuitry, in accordance with a preferred embodiment of the present invention; and

Fig. 19 is a wiring diagram of the frequency selective circuits implemented in the compensation unit of figure 18, in accordance with a preferred embodiment of the present invention; and

Fig. 20 is a schematic block diagram of the slope amplitude equalizer circuit implemented in the compensation unit of figure 18, in accordance with a preferred embodiment of the present invention; and

Fig. 21 is a graphical representation of the dynamic signal attenuation and respective signal boosting points along the transmission pass of a CATV signal from a head-end to a subscriber; and

Fig. 22 is a graphical representation of the dynamic signal attenuation and corresponding signal boosting points along the transmission path of a typical CATV signal from a head-end to a subscriber including compensation units as enhancements, in accordance with a preferred embodiment of the present invention; and

Fig. 23 is a perspective view of the standard coaxial cable connector used in a conventional CATV system; and

Fig. 24 is a perspective view of the standard coaxial cable connector and attached N type coaxial adapter, in accordance with a preferred embodiment of the present invention; and

Fig. 25 is illustrative of the method of connecting the compensation unit into the CATV system employing the standard coaxial connector in combination with a type N coaxial adapter, in accordance with a preferred embodiment of the present invention; and

Fig. 26 is a perspective view of the standard semi-rigid coaxial connector and attached center conductor adapter, in accordance with a preferred embodiment of the present invention; and

Fig. 27 is illustrative of the method of connecting the compensation unit into the CATV system via the utilization of the standard coaxial cable connector and attached adapter to the F type ports.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

The present invention teaches a novel and useful method and system for the expansion of the functional bandwidth of a two-way multi-user communication system. The present invention proposes to improve the performance of CATV systems by the expansion of the infrastructure usable bandwidth capabilities of conventional CATV systems by multiple factors without requiring replacement of the existing coaxial cable infrastructure. Such expansion of the bandwidth can be accomplished by the addition of new advanced CATV components to the system and by the enhancement of existing

CATV system components for enabling two-way forward and reverse transmission of signals over frequencies ranging from about 1GHz to the about 3GHz bandwidth.

In the preferred embodiment of the present invention the communication system is a cable television communication system (CATV) distributing audio, visual, analog or digital information to paying subscribers. Information sources include FM radio broadcasts, local, satellite or microwave TV stations, multi-channel TV programs, video-on-demand services, data communication services, and the like. The proposed system described in detail later hereunder will be referred to as the Extended Bandwidth Cable System (XBCS).

In order to depict in detail the means, through which the proposed objectives are attained, the present invention describes the modifications and additions needed across the entire set of the standard CATV components constituting the CATV infrastructure. The teaching of the method and system encompasses the physical, and the electronic means that will be applied to achieve an optimal level of operation for the proposed system. Such modifications and additions create new components resulting in combination with a new system.

In the typical CATV system information units encoded into electronic signals are received at a transmission center, such as a head-end or a hub station, from a plurality of transmitting information sources. The received signals are suitably processed, frequency-mapped into predefined channels spread across a substantially expanded range of frequencies, multiplexed into a broadband signal modulated across a predefined portion of a substantially increased functional frequency range, and distributed forward to a plurality of subscribers along a controlled transmission path. Transmission of encoded information units modulated across another predefined portion of the same substantially increased frequency range in the reverse direction, from a plurality of subscribers to the transmission center, is also provided. Along the transmission path diverse components operative in dynamically manipulating the required physical characteristics of the transmitted signal as well as in properly maintaining signal parameters vital to the integrity of the reproducible information encoded in the signal, are suitably enhanced by the addition of specific new elements in order to handle the signal modulated across the entire substantially increased transmission bandwidth.

For the sake of clarity the terms "signals" or "data" or "data signals" throughout this application refer to analog or digital signals, including video, audio or any other data representing information. In a preferred embodiment of the invention, the delivery of the information from a transmission center, such as a head end or a hub station, to the subscribers and from the subscribers back to the transmission center is accomplished by impressing encoded information on a carrier wave propagating within the transmission line through the controllable modulation of the frequency of the carrier wave. In addition to frequency modulation other types of modulation methods can be used and fall within the scope of the invention. In addition to television programs and data network packets the signals transmitted within the system may include other types of information such as video-on-demand. In other preferred embodiments of the present invention the communication system could be a satellite communication system, a cellular network, or any other communication infrastructure operative in connecting diverse communication nodes located at remote locations.

Fig. 1A generally depicts the spectra of an existing CATV system. The 35-750 MHz region 12 is utilized for the forward (downstream) transmission of the information impressed on a broadband signal from the head-end to the subscribers. The measure of the total utilized bandwidth is typically the function of the number of active channels in a cable network carrying information from a corresponding number of information sources. As a standard TV channel is allocated a 6 MHz bandwidth under the NTSC standard, a system with a channel capacity of 60 can be realized with a total bandwidth of 550 MHz while a 100-channel system can be realized with a total bandwidth of 750 MHz. Currently different CATV systems utilize different bandwidth sizes. According to the number of channels carried typical systems use the 35-450 MHz band 12, the 35-550 MHz band 14, the 35-650 MHz band 16, and the 35-750 MHz band 18. Where applicable the 5-35 MHz region 10 is utilized as the reverse (upstream) path of signals collected from the subscribers and transmitted therefrom back to the head-end.

Fig. 1B shows the spectra of the proposed XBCS system, in accordance to a preferred embodiment of present the invention. In order to support downward compatibility with the existing CATV systems the 5-35 MHz region 10 is utilized as an upstream path and the 35-750 MHz region 12 is used for the forward (downstream) transmission of the information impressed on a broadband signal from the head-end to

the subscribers. In addition to the existing 50-750 MHz CATV mapped downstream region 12, an extended frequency region (XFR) 21, is added to the usable bandwidth. In the preferred embodiment of the present invention, the XFR 21 is allocated a frequency range of about 2000 MHz by defining the lower and upper limits of the region 21 as 1000 MHz and 3000 MHz respectively. . The XFR 21 can be divided into downstream and upstream portions in accordance with the system's mode of operation. The system could operate in an asymmetric mode or a symmetric mode. The term asymmetric refers to a mode of operation in a two-way communication system in which the data speed or the quantity of data transmitted differs in one direction as compared with the other direction, averaged over time. Conversely, the term symmetric refers to a mode of operation in which the data speed or the quantity of data transmitted is equal in both directions .In the preferred embodiment of the present invention, in the symmetric mode, the XFR 21 of about 2000 MHz is divided into an about 1000 MHz upstream sub-region extending across the about 1050-1950 MHz range 19, and an about 1000 MHz downstream sub-region 20 extending across the about 2150-3000 MHz range. The additional frequency ranges 19, 20 are having additional channels mapped therein thereby providing substantially increased capacity in regard to the number of extra information sources and services to be provided to the subscribers. In the asymmetric mode, the XFR 21 of about 2000 MHz that extends across the entire of about 1000-3000 MHz range is utilized entirely as the downstream sub-region. For the upstream transport the 5-35 MHz region 10 is used. The considerably extended usable bandwidth of the proposed system, apparatus and method allows the XFR 21 can be partitioned such that close proximity of the upper limit of a lower frequency band to the adjacent lower limit of a neighboring higher frequency band is avoided. The XFR 21 can be divided into non-contiguously allocated frequency range slots by the insertion of guard bands having a predefined range value between two neighboring frequency bands. As a result, no interference will occur among the different frequency bands along the respectively separated boundaries thereof.

According to the functionality, the operational mode and the configuration of the cable plant, the partitioning of the XFR 21 into functional sub-regions by the allocation of specific frequency bands to respective sub-regions, could be made by using diverse methods in order to achieve optimal performance of the system. For example, in

the asymmetric operational mode, the downstream path could be allocated a 1800 MHz range while the upstream path could be allocated a 200 MHz. Different partitioning methods will result in different range values. For example the XFR 21 can be divided into an upstream frequency band and a downstream frequency band in the following manner. (For the clarity of the description non-contiguous partitioning is avoided in the example).

Upstream : 1600 MHz Downstream : 400 MHz
Upstream : 1500 MHz Downstream : 500 MHz
Upstream : 1400 MHz Downstream : 600 MHz
Upstream : 1200 MHz Downstream : 800 MHz
Upstream : 1100 MHz Downstream : 900 MHz

....

Upstream : 500 MHz Downstream : 1500 MHz

....

It would be obvious to one with ordinary skill in the art that diverse other partitioning formulas are available to accomplish a plurality of frequency limit variations and transmission path combinations resulting from the diverse allocation methods of frequency range values.

As a result of the known frequency response characteristics of signals in the higher frequency ranges the XFR 21 of about 1000-3000 MHz bandwidth supplies substantially lower amplitude values in respect to the standard value maintained by the regular CATV system by about −15dB. In the preferred embodiment of the present invention, in order to boost the signal level of the XFR 21 of about 1000-3000 MHz to the operative level, the existing CATV infrastructure is overlaid with additional XBCS new elements designed to equalize the signal level differences across the range of frequencies added.

It will be easily perceived by one with ordinary skill in the art that the details, the range of frequency domains, and the respective quantitative figures given in the foregoing description are merely exemplary. The details disclosed should not be interpreted as limitations but merely as example instrumental to a clear understanding of the present invention.

The operation of an existing CATV system is described referring to Fig. 2. Fig. 2 shows a block diagram of a standard CATV system. A plurality of information sources 22, 24, 26, 28, 30 transmit information units encoded into electrical signals to respective channel modulators 22`, 24`, 26`, 28`, 30`. Following appropriate requests by a subscriber, digital data encoded into electrical signals is sent from a digital data network 32 to a data network browser 34 at the head-end 36. The plurality of signals from the channel modulators 22', 24', 26', 28', 30' are multiplexed into a broadband signal and fed downstream via a main drive amplifier 38 to a splitter 40. The splitter 40 divides the signal carried on the cable and distributes the signal downstream simultaneously to local subscribers 42 via a line amplifier 44 and to remote subscribers 46 via long line 41. Long line 41 is typically a fiber-optic cable. The signal is transported through trunk cables, local hubs 48, 50, 52, feeder (or distribution) cables, taps or multi-taps, and drop cables. According to the topography of the system one or more line amplifiers 54, 56, 58, 60, 62 are installed along the transmission path. The local hub station 52 receives directly digital data from data communication network 32 via local data network browser 62. Upstream information collected from the subscribers 42, 46, 54, 56, 58 is conveyed upstream to a CPU 64 at the head-end 36 to be used for billing purposes, payments, and for accessing a data network 32 via the head-end data network browser 34. Additional components could be connected to the units described above.

The functional spectral width of a typical CATV system is limited. The network operators have maximized the number of active TV channels for broadcasting to their customers thereby utilizing practically the entire range of frequencies available for effective information transmission. Therefore to discontinue the operation of an active channel in order to dedicate the corresponding channel to a data communication network access would be problematic and costly. An extension of the spectral width is needed to enable the insertion of additional information sources into the information mix carried by the common signal.

Having described the standard CATV system in general the various components of the CATV system and the XBCS components will now be described in further detail showing the various additions and enhancements to the components of the CATV system showing the XBCS system.

Generally, the modifications to the infrastructure of the CATV system are realized by introduction of specific new elements in tandem with the existing elements. The new elements can be introduced into the distribution plant independently of existing elements when needed. Existing components within the distribution plant are not replaced but overlaid with additional XBCS elements. The addition of specific new elements and/or the rearrangement of existing elements modify some elements such as the subscribers' home outlets and the nearest splitters to the home outlets. In some topographical areas in order to maintain an acceptable level of performance the transmission line will have to be disconnected, an XBCS new module will have to be introduced into the system, and then the line will have to be reconnected through the new module. For the purpose of clarity we be begin the description with the subscriber's home outlet making our way in reverse (upstream) direction, via the home outlet splitter, the set-top unit, the hub station, the compensation unit, and the improved cable connectors.

Fig. 3 illustrates the schematics of an existing CATV system subscriber home outlet. Broadband signals received as input from the CATV network are fed into the home outlet through an RG-11 type coaxial cable 66 and reverse signals are fed from the outlet to the CATV network through the same path provided by the RG-11 type coaxial cable 66. The coaxial cable 66 is soldered or F-connected to the wall outlet 70. The wall outlet 70 provides a TV F-connector 68 or similar connector and a FM radio connector 69.. The broadband signal is fed from the termination surface 78 of cable 66 to the home outlet circuitry. The FM radio signals are split from the broadband signal by a standard 75-100 MHz FM band pass filter 72 and fed into the FM outlet 69. Signals modulated above 50 MHz are fed to TV outlet 68. Signals in the 5-35 MHz range are trapped by trap 74. The home outlets have to accept the upstream return path of 5-35 MHz. Reverse signals in the 5-35 MHz transmitted from the subscriber are fed into the outlet through the TV outlet 68, and via wall outlet 70 are transmitted to the head-end.

Referring now to Figs. 4 and 5 that show a schematic illustration of an XBCS CATV subscriber home outlet and the electrical circuitry of a XBCS CATV subscriber home outlet. The XBCS home outlet shown is a standard CATV home outlet that was modified in order to enable the transmission of a broadband signal having a

frequency range of about 5 MHz to about 3000 MHz An added stripline Super High Frequency (SHF) diplexer 76 is incorporated into the standard CATV system home outlet in the following manner. The standard CATV FM bandpass filter 72 and the upstream 5-35 MHz trap 74 are sandwich connected to the XBCS outlet port 78. Consequently, the modified XBCS home outlet is still provided with the full capability regarding standard CATV operations, such as the passing of the 5-35 MHz return path upstream and the passing of the 50-750 MHz to the subscriber. Additionally the outlet provides the capability of adding to the current usable bandwidth an additional operative spectral band of about 1000 MHz to about 3000 MHz. The new band is split in two by the diplexer 76 in order to provide a symmetrical downpass and an uppass of at least about 1000 MHz to each direction. The XBCS home outlet provides standard CATV signal levels of 75 dBmV for cable TV while maintaining the FM levels, and the 5-35 MHz upstream characteristics. For the about 1050-1950 MHz band and the about 2150-3000 MHz band the built in stripline filters engineering maintains 75-ohms impedance.

Referring now to Fig. 6 illustrating the asymmetrical XBCS CATV set-top logic. When adding about 3 GHz of spectrum on top of the existing CATV bandwidth to be utilized as downstream region only, a digital satellite tuner 80 with a bandwidth 36 MHz and an IF frequency of 72 MHz is used. The tuner 80 enables control of a plurality of additional channels having data transfer rates up to about 10 Gbps. As a result, the XBCS system's performance is substantially equivalent to the performance of a very high speed Ethernet network. Gbps. A RF switch 82 is used for selecting direct standard CATV operations or down conversion from the XBCS bandwidth of about 1000-3000 MHz to about 72 MHz for the Digital Broadcast Video service. The unit is supplied +12V DC 84 via a fused separation diode 88.

Referring now to Fig. 7 which illustrates the difference between the symmetrical XBCS set top box and the asymmetrical XBCS set top box of Fig. 6. A stripline filter arrangement is engineered to separate of the main streams. The stripline filter 84 isolates the standard CATV 5-750 MHz band and directs it directly or via the RF switch 82 of Fig. 6 to the standard CATV set-top 89 in use. Consequently the about 2150-3000 MHz band is picked up by the about 2150-3000 MHz stripline pickup 83 and fed to a broadband about 2150-3000 MHz 73 tuner which delivers IF of 72 MHz and

decodes digital data which is fed to a two-way modem 88 downstream. The two-way modem 88 directs the upstream information from the subscribers computer to a modulator exciter 90 in the about 1050-1950 MHz band whose output is collected by the about 1050-1950 MHz stripline insertion diplexer 92 feeding it back via the CATV network to the nearest hub. The types of modulation, coding, demodulation, and decoding methods will be adjusted according to the type of the CATV systems within which the proposed method is operative.

If the subscriber is not a single user within the area supplied by a specific tap but a part of commonly owned apartment house or condominium arrangement it is more than likely that the standard connection thereof will be to a passive splitter. This splitter can be an about –3dB divider or any up to times 8 divider (about -10dB). The usual length of the RG-11 cable from this splitter to the subscriber home outlet can reach up to 100 feet. Whenever an odd number of subscribers are connected to a dividing splitter a 75-ohm passive load termination is used.

Fig. 8 illustrates the XBCS CATV four-way splitter located nearest the subscriber home outlet. The standard CATV last splitters are 5-900 MHz passive splitters. As the nearest splitter is at a distance of about 100 feet from the subscriber home outlet the about 1000-3000 MHz asymmetrical or the split symmetrical information will suffer a substantial loss due to the RG-11 characteristics. To compensate for the loss modifications are applied to the splitter. The signal is fed from the CATV network via input port 820. Filter 822 separates the 1050-3000 MHz frequency band from the signal and feeds the signal to gain and slope adjusted amplifier 802. The amplifier 802 values are calculated for driving the XBCS signal in order to overcome the losses of the RG-11 cables connected to the subscribers home outlets. The modifications of the splitter divider are connected in parallel to standard 5-900 MHz circuitry without influencing each other. Power to drive the amplifier is provided through separation diodes 812, 814, 816, 818, which are connected to all four 804, 806, 808, 810. The amplifier 82 will be performing as long as the XBCS set-top of the four subscribers connected via ports 804, 806, 808, 810 is operating. The amplified signal is divided to four signals by a 1000-3000 MHz quadroplexer 804 and fed via the output ports 804, 806, 808, and 810 to the respective subscribers.

Figs. 9A, 9B show a specific example of a distributed layout of a 4-divider splitter configuration, in accordance with a preferred embodiment of the present invention. The exemplary 4-divider splitter divides the signal to four subscribers such that the subscribers are enabled upstream and downstream communication while the standard CATV feed is kept intact.

Fig. 9A illustrates a mechanical layout of the 4-divider splitter's downstream segment. The broadband signal fed from the CATV network via input port 701 is passed to filter 702. Filter 702 passes the frequencies of the broadband signal within the 2150-3000MHz downstream frequency portion to amplifier 704. The signal is suitably amplified and driven by amplifier 704 to quadroplexer 706 which splits the signal to four subscriber outlet units via output ports 708, 710, 712, 714.

Fig. 9B illustrates the mechanical layout of the 4-divider splitter's upstream segment. The four separate upstream signals that were generated by the subscribers are fed from the suitable set-top box extensions via the subscribers' home outlets to the splitter ports 708, 710, 712, and 714. The four separate signals are combined by the quadroplexer 722 and passed to upstream amplifier 720. Amplifier 720 amplifies and drives the multiplexed signal to the stripline filter 703. Filter 703 passes the 1050-1950 MHz upstream frequency portion of the combined signal via output port 701 to the CATV network.

Fig. 9C shows the electrical layout of the 4-divider splitter. The broadband signal is fed from the CATV network via input port 701 to a set of filters. Filter 715 separates the 5-750 MHz conventional CATV frequency band from the broadband signal. The signal included in the separated frequency band signal is divided into four and transmitted to four respective subscribers via the splitter's output ports 708, 710, 712, and 174. Filter 702 separates signals within the 2150-3000 MHz frequency range. The separated signals are amplified by downstream amplifier 704 and divided into four parts by the interaction of circuits 706 via inductive coupling. The four exits of the respective circuits 706 are connected to the splitter's output ports 708, 710, 712, and 714. The divided signals are fed via the ports 708, 710,712, and 714 to the respective subscribers' home outlets. Upstream signals generated by the subscribers are suitably fed by the subscribers' set-top boxes to the splitter's output ports 708, 710,712, and 714. The signals are combined into the broadband signal by the interaction of circuits 722 via

capacitive coupling and fed to upstream amplifier 720. The signal is suitably amplified by amplifier 720 and fed through filter 703. Filter 703 separates the 1050-1950 MHz upstream frequency band and feeds the filtered signals to the splitter's to the CATV network via input port 701 of the splitter.

Referring to Fig. 10 which illustrates the existing mechanical connections between the CATV network and the hub station thereof. In accordance with the preferred embodiment of the present invention an important consideration regarding the installation of the XBCS is the manifest undesirability of modifying active components and particularly existing hub stations. Thus, the expansion of about 2 GHz asymmetrical or about 1000 MHz symmetrical bandwidths is achieved only by minor external connection changes. As illustrated in Figure 10, conventionally, heavy coaxial cable 102 in connected to hub station 104. The hub station 104 also includes a connection point 101 to a fiber-optic cable.

Figure 11 shows a diagram showing the mechanical introduction of a proposed hub enhancement into the XBCS hub. The introduction of an XBCS compensation module between the CATV network and the hub station enables the operation of the XBCS system and allows the transmission of high frequency signals in ranges between the about 1000MHz and the about 3000MHz. The XBCS module 106 is introduced to the ordinary CATV system. An asymmetrical or symmetrical XBCS module is to be added to the CATV system in the following manner. The heavy coaxial cable 102 is disconnected from the existing hub 104 and reconnected to the XBCS hub module 106 input while the parallel XBCS hub module 106 input free coaxial cable 107 is connected to the hub 104 input connection point. Similarly the heavy coaxial cable 105 is disconnected from the hub 104 and reconnected to the XBCS hub module 106 output while the parallel XBCS hub module 106 output free coaxial cable 103 is connected to the hub output.

Figure 12 shows a combined schematic block diagram and a general view illustrating the new hub module of the XBCS system. The XBCS hub module can operate in an asymmetrical mode. The drawing illustrates the asymmetrical XBCS hub compensation module. The module adds gain and slope to losses of the about 1000-3000 MHz bandwidth, which in the asymmetrical mode is entirely dedicated to the transmission of the additional downstream signal. The change in or to the standard 5-35

MHz, and the standard 48-750 MHz is negligible (less than 1 dB) as the about 1000-3000 MHz traps [illegible] connected in series to the "IN" and "OUT" hub connectors. In Fig. 13 the asymmetrical XBCS hub module for the local hub data insertion is shown. No changes in the input to the hub are necessary since only the channels mapping and 3-35 MHz upstream towards the head-end is being fed. The output from the hub is disconnected and inserted via the new module.

Figure 14 shows a general view illustrating the mechanical introduction of a new symmetrical hub module into a typical CATV hub. The heavy coax connector to the hub is not modified in respect to the standard CATV hub. The heavy coaxial cable output 121 from the hub 120 is reconnected via the XBCS hub 122 to the XBCS hub 122 output 123. In XBCS symmetrical operation data is fed in the upstream direction with same bandwidth as the downstream. Therefore the XBCS symmetrical hub unit structure and operation are different from the asymmetrical which is eventually adding about 2000 MHz in bandwidth to the downstream direction. The about 1050-1950 MHz added band is upstream data collected from the subscribers and fed to the data routers connected via fiber optics to the hub. The same data routers are feeding the about 2150-3000 MHz bandwidth with modulators exciters for data loads downstream to the subscribers.

Fig. 15 shows the XBCS symmetrical hub unit circuitry including the XBCS data communication unit. A typical hub assembly feeds a community of about 2000 neighboring subscribers. It is a common practice to interconnect the hub assembly to data supplying routers and peripherals. The XBCS data communication unit 130 is a duplex receiver/transmitter having a speed of at least 800 Mbps for each direction in parallel. Types of data modulation and encoding, demodulation and decoding are given to the CATV operator's decisions. The symmetrical XBCS provides a carrier platform of about 2000 MHz to be used as desired. The spectral density and location for each of the about 2000 hub subscribers is controlled by a CPU 132, which is locally controlled when installed in the head-end assembly or remotely controlled from the head-end when installed on the hub station. The XBCS system uniquely utilizes the already laid coaxial cables in order to supply in duplex high-density high-speed data from the hub to the subscribers. The XBCS system is also unique in using the already existing infrastructure devices and the additions and modifications installed to secure and control the bandwidth expansion to the about 3 GHz bandwidth. In a CATV system enhanced with XBCS units

all the "IN" and "OUT" connections belonging to any active line distribution device such as bridging amplifiers, and line amplifiers or belonging to passive line power splitters have to be disconnected and reconnected via XBCS symmetrical or asymmetrical compensation unit.

Referring to Fig. 16 the XBCS compensation unit can be connected as a symmetrical or as an asymmetrical unit. The standard XBCS compensation unit is engineered in such a way as to pass all the existing CATV signals of 5-750 MHz including the 50-60 Hz line power distribution links. The unit has two amplification segments. The about 2150-3000 MHz segment is always connected as a downstream adder. Where symmetrical operation is desired the about 1050-1950 MHz amplifier module 140 can be connected in reverse to serve as an upstream amplifier.

Figure 17 shows a graphical representation of the introduction of the proposed compensation unit as a standalone signal booster into the CATV system. The XBCS compensation unit can be used as a standalone unit whenever it is needed for refreshing the signal and overcoming line drop losses due to infrastructure topography, such as transmission of the signal in overlong cables. The unit rejuvenates the XBCS signal at existing taps, connectors, splitters, and the like. The existing cable is disconnected at designated points, which were found by calculation and the XBCS compensation unit is introduced into the system.

Referring to Fig. 18 which is schematic block diagram illustrative of the XBCS compensation unit of Fig. 17. Compensation unit 202 is coupled to line distribution device 200 via two connection points: "IN" connection point 260, and "OUT" connection point 262. "IN" connection point 261 of device 200 is coupled to "IN" connection point of compensation unit 202 via "IN" connection point 261. "OUT" connection point 264 of device 200 is coupled to "OUT" connection point 262 of compensation unit 202. Line distribution device 200 contains a typical CATV amplifier unit 201. For example unit 201 could be a bridging amplifier, a component that typically provides service into the distribution or feeder systems. The compensation unit 202 could be connected to any other typical CATV line distribution devices, such as line amplifiers or signal splitters. The compensation unit 202 comprises RF chokes 205, 206, 208, multiplexer filter sections 210, 220, downstream amplification section 229, upstream amplification section 231, and power supply 204. In the compensation unit 202

the RF signal is to be processed in a RF device. Therefore, the AC power signal must be separated from the RF signal in the compensation unit 202. A RF choke is utilized to separate the single-phase AC power signal from the broadband RF signals. The capacitor blocks AC power from the frequency selective devices. After passing the device, the AC power is recombined with the broadband signal, by utilizing a second RF choke. In the compensation unit 202 RF chokes 205, 206, 208 are operative in separating and recombining the line power frequencies, necessary for the operation of amplifiers and other devices along the transmission path, from the RF signal transmitted through the line. Multiplexer filter sections 210, 220 are combinations of frequency selective devices, which operate at three different ranges of frequencies. Multiplexer filter sections 210, 220 consist of three frequency selective circuits categorized by the location of their passband. Downstream amplification section 229 comprises pad 230, gain equalizer 232, amplifier 234, tilt equalizer 236, and amplifier 238. Upstream amplification section 231 comprises pad 240, gain equalizer 242, amplifier 244, tilt equalizer 246, and amplifier 248. The function of amplifiers 234, 238, 244, 248 is to increase the amplitude or the power of the signal within a selected frequency range. In order to obtain any desired amplification the amplifiers should be suitably connected in sequence. Thus, the basic unit is a single-stage downstream amplifier 234, 238, and the single-stage upstream amplifier 244, 248 consist of the active device and all the associated components that accompany such a stage. Downstream pad 230 and upstream pad 240 are adjustable resistance networks utilized for the tuning of the respective amplification sections thereof. Downstream equalizers 232, 236 and upstream equalizers 242, 246 allow control of the gain, slope and amplitude of the signal in order to correct cable attenuation slope over frequency introduced into the signal by the cable. Multiplexer filter segment 210 comprises low pass filter (LPF) 212, high pass filter (HPF) 214, and band pass filter (BPF) 216. Multiplexer filter segment 220 comprises low pass filter (LPF) 222, high pass filter (HPF) 224, and band pass filter (BPF) 226. The filters 212, 214, 216, 222, 224, 226 are predetermined arrangements of electronic components that allow only specific frequencies lying within a predefined range, or a band of frequencies to pass, and block all the other frequencies. In the preferred embodiment of the present invention LPF 212 and LPF 222 are designed to pass frequencies in the about 5 -750 MHz range. The about 5-750 MHz range includes the signal components impressed with information

to be transferred within the conventional CATV channels in the downstream/upstream direction, i.e., from/to the head-end to/from the subscribers. Similarly, HPF 214 and HPF 224 pass the about 2150-3000 MHz range of frequency components to transmit information impressed therein in the downstream direction from the head-end to the subscribers. In the preferred embodiment of the present invention BPF 216 and BPF 226 pass the about 1050-1950 MHz frequency band operative in holding information impressed therein, which is transmitted upstream from the subscribers to the head-end as a reverse signal. The broadband signal transmitted from the head-end in the downstream direction is fed to the compensation unit 202 via "IN" connection 203. The line power elements of the signal are separated by RF choke 206, 208. The signal is fed to multiplexer filter section 210. In order to pass the 5-750 MHz band of frequencies unmodified, LPF 212 extracts the range of frequency components in the 5-750 MHz range and transfers the components to bridging amplifier 201 contained in the line distribution device 200. The signal components are suitably processed by bridging amplifier 201 and LPF 222 and are fed via connection point 204 to be transmitted to the subscribers. HPF 214 extracts the band of frequency components in the 2150-3000 MHz range and feeds the components to downstream amplification section 229. Downstream pad 230 is an adjustable resistance network operative in the suitable tuning of the components within the section 229. The signal is processed and amplified appropriately by amplification section 229 and subsequent to filtering by HPF 224 is fed via connection point 204 to be transmitted to the subscriber downstream. BPF 226 extracts the band of frequency components in the about 1050-1950 MHz range and feeds the frequency components to upstream amplification section 231. Upstream pad 240 is an adjustable resistance network operative in the suitable tuning of the components within the section 231. The signal is processed and amplified appropriately by amplification section 231 and subsequent to filtering by BPF is fed via connection point 203 to be transmitted to the head-end. Note should be taken that in other embodiment of the present invention the about 1050-1950 MHz band of frequencies could be utilized as an additional downstream path. It will be clear to one with skill in the art that in the above mentioned different embodiment the processing sequence of the amplification section 231 will have to be operatively reversed in order to enable the proper processing of the RF signal.

Referring to Fig. 19 that shows a schematic block diagram of the filter section 210 and 220 of Fig. 18. The composition and the functions of filter section 210 and of filter section 220 are substantially identical. Thus, only filter section 210 is illustrated in the drawing. Filter section 210 comprises BPF segment 300, BPF section 306, HPF segment 310, and LPF segment 320. The specific component values on the block diagram reflect the respective bandwidths designed to be passed and or to be blocked by the filter segments within which the components are included. It will be easily perceived by one with ordinary skill in the art that the different filter segments could be set to any bandwidth within the about 1000-3000 MHz band by changing the suitable component values. The type of the amplifier utilized within the system of the present invention could be of a wide variety of different products. For example an off-shelf product may be used as the standard amplifier to be utilized in the compensation units. One such amplifier is the "Linear CATV Amplifier Type RF-2317" manufactured by the RF Micro-Devices, Inc. of Greensboro, NC, USA. Other substantially similar products with substantially similar attributes and features may be implemented.

Fig. 20 shows a schematic block diagram of the slope amplitude equalizer circuit implemented in the compensation unit of figure 18. The equalizer provides amplitude and slope compensation allowing for the equalization of effects contributed by cable runs and components inherent in the existing design. The amplifiers within the system are used to compensate for the attenuation of the signal levels. However, even after amplification, the higher frequencies are at lower levels than the lower frequencies. Therefore, the included equalizer circuits attenuate lower frequencies of the cable signal to provide relatively flat signal levels. The equalizer circuit for the reverse direction also compensate reverse signals, as necessary, so that relatively flat response of the reverse signal levels are provided to the head-end.

Fig. 21 graphically illustrates an exemplary transmission path including diverse CATV components from the head-end to the subscriber in a standard CATV system. The CATV system parameters are pre-calculated and the entire CATV system infrastructure is equipped to fit the various topographical and local environments in order to achieve the transmission of a signal with the suitable characteristics to all the

subscribers with a minimum distortion and noise. The signal tree combination is a typical pattern of all and any CATV system. Various software systems operative in calculating the optimal system values are available that take into account the various parameters of the heavy coaxial cables in use, the active elements chosen, the passive splitters, and the drop sections up to the subscriber. All those parameters when adjusted to given lengths of the interconnection can be pre-calculated and create the signal tree assignment. In the standard CATV systems the signal tree assignment values are pre-calculated for the 48-750 MHz bandwidth only.

Fig. 22 graphically illustrates an exemplary transmission path to the subscriber in the XBCS system. XBCS system pre-calculation is taking care of drop losses in the heady coaxial cables and an XBCS compensation unit is installed whenever needed. Any other preinstalled devices will carry a new XBCS unit in such a way that the XBCS signal practically never drops below the specifically predefined level. The method and system of present invention proposes to substantially extend the usable bandwidth of a cable television communication network.

The signal can be modulated across a frequency range with an upper limit of about 10GHz. As a result of amplifier dynamics, the conventional CATV cable connector assemblies effect spectral response decay above frequencies of about 1GHz. In order to enable transmission of signals within the substantially higher bandwidth limits and having a substantially correct spectral response, the present invention proposes an improvement in the existing cable connector assemblies. The correct spectral response will be maintained by the attachment of specific adapter units.

Referring to Fig. 23 that illustrates the existing cable connector assemblies employed in a conventional CATV system. The standard cable connector assembly 500 contains body 502, threaded fastener 504, thread 506, cable 501, and inner conductor 508. Cable connector assemblies of this type effect spectral response decay when passing signals, which were modulated into frequency bands lying across the GHz range. Fig. 24 shows the proposed solution to the problem of the spectral response decay. In the preferred embodiment a type N RF coaxial adapter 510 is fitted to the standard cable connector 500. The attachment of the adapter 510 to the cable connector 500 is accomplished by the cutting of inner conductor 508 of Fig. 24 and by the suitable fastening of conductor 508 of Fig. 24 to adapter 510.

Fig. 25 shows the method of introducing the compensation unit 506 into the signal path within the proposed system. Cable connector assembly 520 with attached type N adapter 522 is coupled as line "IN" to compensation unit 524. Cable connector 526 with attached type N connector 528 is coupled to compensation unit 524 as line "OUT". The compensation unit 524 is connected to the CATV device 530 via standard cable connector assemblies 532, and 534. Female or Male Type N connectors are capable of passing signals through the cable television system, utilizing a frequency range with an upper limit of about 10GHz, while maintaining a proper spectral response. The type of the type N adapter utilized within the system of the present invention could be of a wide variety of different products. For example an off-shelf product may be attached to the standard cable connectors. One such product is the "N-series RF Coaxial Connector" manufactured by the Gilbert Engineering Co. of Glendale, Arizona, USA. Other substantially similar products with substantially similar attributes may be implemented. Female or Male Type F connectors are capable of passing signals through the cable television system, utilizing a frequency range with an upper limit of about 10GHz, while still maintaining a proper characteristics of the signals.

Fig. 26 illustrates the adaptation of a standard semi-rigid connector assembly the system. The adaptation is done by the attachment of a female-to-female center conductor adapter known as slice cable connector. The center conductor to the F connector outlet (male or female as needed) is mounted to the open end of the slice adapter. The connector assembly 601 includes semi-rigid cable 602, semi-rigid connector body 604, center conductor to F (male or female) 608, and center conductor adapter 606.

Fig. 27 shows the method of introducing the compensation unit 610 into the signal path within the proposed system. Cable connector assemblies 612, 616, 622, 624 having center conductor adapters attached are coupled to F type female ports 614, 618, 622 and 624 respectively. In addition, standard concentric cable connectors 630, 632, 634, 636 are coupled to ports 638, 640, 642, 636 of compensation unit 610 respectively.

It will be apparent to one skilled in the art that the above description facilitates a thorough understanding of the present invention and should not be construed as limiting to other possible embodiments and alternative uses that could be contemplated without departing from the spirit of the invention or the scope of the appended claims. It will be clear to one skilled in the art that the foregoing description is

merely exemplary. In other embodiments of the present invention additional components could be used or the detailed components could be replaced by functionally similar units without significantly depart from the underlying scope of the present invention. The scope of the proposed method and system should be limited only by the scope of the attached claims. While the present invention is described in the context of a fully operational communication network, those skilled in the art will appreciate that the present invention is fully capable of being applied in a variety of forms and the method and system applies regardless of the particular type of network configuration utilized. In view of the above description of the preferred embodiment of the present invention, many modifications and variations of the disclosed embodiment will be readily appreciated by those with skill in the art. It is therefore to be understood that within the scope of the appended claims the invention may be practiced otherwise that specifically described above.

WE CLAIM:

1. A system for extending the transmission path across a range of frequencies, the system comprising:

a compensation unit for dividing and amplifying a signal;

a home outlet splitter unit for splitting and amplifying a signal; and

a home outlet unit for expanding bandwidth and filtering frequencies; and

an extension unit to a set-top box; and

an enhanced cable connector assembly for transmiting a signal;

2. whereby enabling transmission of data at substantially higher data rates . The system of claim 1 further comprising a data communication unit for communicating data.

3. The system of claim 1 further comprising a hub-station unit for adding gain and slope to losses of a signal transmitted and combining the signal transmitted by atransmission center with a signal transmitted by a data communication unit.

4. The system of claim 1 wherein the communication network is a CATV (Cable Television) system utilizing a plurality of transmission channels.

5. The system of claim 1 wherein the compensation unit comprises;

frequency band divider means to separate at least two signal streams for selective processing;

downstream signal amplifying means for amplifying a signal representative of information units transmitted by an transmission center to users; and

upstream signal amplifying means for amplifying a signal representative of information sent by users to an transmission center.

6. The system of claim 1 wherein the compensation unit further comprises;

an input for receiving a downstream signal and for transmitting an upstream signal;

at least one frequency selective circuit coupled to the input for separating at least two different bands of frequencies of the downstream signal and the upstream signal;

an equalizer circuit coupled to the output of the frequency selective circuit for attenuating lower frequencies of the downstream signal and the upstream signal modulated across at least one band of frequencies; and

at least one output providing the downstream signal after being processed by the frequency selective circuit, the equalizer circuit, and the amplifier circuit and for receiving the upstream signal from the equipment the compensation unit is coupled to.

7. The system of claim 1 wherein the compensation unit further comprising;

an amplifier circuit coupled to the output of the equalizer circuit for the amplification of the downstream signal and the upstream signal modulated across at least one band of frequencies.

8. The system of claim 1 wherein the compensation unit further comprising:

a communication network line distribution unit coupled to the output of the compensation unit for receiving at least one downstream signal, the line distribution unit having an output for providing the downstream signal and a upstream signal for processing by other network equipment.

9. The system of claim 5 wherein the frequency selective circuit comprising:

a low pass filter having an output coupled to the cable television network line distribution unit to selectively process a selected band of frequencies of the downstream signal and the a selected band of frequencies of the upstream signal; and

a high pass filter having an output coupled to the equalizer and amplifier circuits to selectively process a selected band of frequencies of the downstream signal and a selected same band of frequencies of the upstream signal.

10. The system of claim 6 wherein the equalizer circuit comprises a high pass filter.

11. The system of claim 3 wherein the hub station unit comprises:

means for adding gain and slope to losses of the signal transmitted in the downstream direction froma transmission center to the users;

means for adding gain and slope to losses of the signal transmitted in the upstream direction from the users to a transmission center; and

multiplexer means to combine the signal transmitted by a transmission center with the signal transmitted by a data communication unit.

12. The system of claim 2 wherein the data communication unit comprises:

receiver-transmitter means to receive data from a data communication network and to transmit data to the data communication network;

demodulator-modulator means to encode data to a data communication network; and

data router means to direct data to a data communication network and to direct the data to a central processing unit for processing; and

processing means to compute the location and spectral density of users.

13. The system of claim 1 wherein the home splitter unit comprises:

divider means to split the signal modulated across the extended range of frequencies to a varied number of users; and

amplifier means to compensate for the losses in the signal due to line characteristics.

14. The system of claim 1 wherein the home outlet unit comprises:

bandwidth expanding means to add to the standard usable bandwidth a extended range of frequencies; and

filtering means to separate the appended extended range of frequencies to downstream and upstream pass regions.

15. The system of claim 1 wherein the information unit encoded into electronic signals carry video, sound, and data content received from external information sources.

16. The system of claim 5 wherein the compensation unit is connected to the communication network to refresh the transmitted signal and to overcome line drop losses due to network infrastructure topography.

17. The system of claim 5 wherein the compensation unit is connected as an enhancement unit to the existing components of the communication network.

18. The system of claim 5 wherein the compensation unit is connected to the communication network as a standalone unit.

19. The system of claim 5 wherein the compensation unit connected to the communication network as a symmetrical unit to support two-way symmetrical transmission of signals.

20. The system of claim 5 wherein the compensation unit is connected to the communication network as an asymmetrical unit to support two-way asymmetrical transmission of signals.

21. The system of claim 11 wherein the hub station unit is connected as an enhancement unit to the existing local hub of the communication network.

22. The system of claim 11 wherein the hub station unit connected to the communication network as a symmetrical device to support two-way symmetrical transmission of the signals.

23. The system of claim 11 wherein the hub station unit is connected to the communication network as an asymmetrical device to support two-way asymmetrical transmission of the signals.

24. The system of claim 12 wherein the data communication unit is operative in connecting the hub station unit with the external data communication network providing information content.

25. The system of claim 13 wherein the home splitter unit connected to the communication network as a symmetrical device to support two-way symmetrical transmission of the signal.

26. The system of claim 13 wherein the home splitter unit is connected to the communication network as an asymmetrical device to support two-way asymmetrical transmission of the signals.

27. The system of claim 1 wherein the enhanced cable connector assembly comprises;

a coaxial cable connector for transmiting the downstream signal and the upstream signal between the components of a cable television system; and

a coaxial adapter physically attached to the standard coaxial connector, operative in transmitting frequencies up to 10GHz.

28. An extension unit to a set-top box comprising the elements of:

tuner means for controlling the additional channels within the extended range of frequencies;

switching means to enable selection of mode of operation; and

filtering means to separate the appended extended range of frequencies to downstream and upstream pass regions; and

modem means to encode the information and transmit the data to the user; and

modem means to decode the information received from the user and transmit the information upstream to the trasmission center.

29. The extension unit to the set-box according to claim 28 wherein the extension unit to the set-top box is connected to the communication network as a symmetrical device to support two-way symmetrical transmission of the signals.

30. The extension unit to the set-top box according to claim 28 wherein the extension unit to the set-top boxt is connected to the communication network as an asymmetrical unit to support two-way asymmetrical transmission of the signals.

31. The extension unit to the set-top box according to claim 28 wherein the extension unit to the set-top box transmits practically the entire frequency range of existing CATV signals practically unmodified at practically the standard power levels.

32. A compensation unit dividing and amplyfing a signal comprises;

frequency band divider means to separate at least two signal streams for selective processing;

downstream signal amplifying means for amplifying a signal representative of information units transmitted by a transmission center to users; and

upstream signal amplifying means for amplifying a signal representative of information sent by users to an transmission center.

33. The compensation unit of claim 32 further comprises;

an input for receiving a downstream signal and for transmitting an upstream signal;

at least one frequency selective circuit coupled to the input for separating at least two different bands of frequencies of the downstream signal and the upstream signal;

an equalizer circuit coupled to the output of the frequency selective circuit for attenuating lower frequencies of the downstream signal and the upstream signal modulated across at least one band of frequencies; and

at least one output providing the downstream signal after being processed by the frequency selective circuit, the equalizer circuit, and the amplifier circuit and for receiving the upstream signal from the equipment the compensation unit is coupled to.

34. The the compensation unit of claim 32 further comprising;

an amplifier circuit coupled to the output of the equalizer circuit for the amplification of the downstream signal and the upstream signal modulated across at least one band of frequencies.

35. The compensation unit of clainm 32 further comprising:

a communication network line distribution unit coupled to the output of the compensation unit for receiving at least one downstream signal, the line distribution unit having an output for providing the downstream signal and a upstream signal for processing by other network equipment.

36. A hub station unit for adding gain and slope to losses of the signal transmitted and for combining the signal transmitted by an transmission center with a signal transmitted by a data communication unit the hub station comprises:

means for adding gain and slope to losses of the signal transmitted in the downstream direction froma transmission center to the users;

means for adding gain and slope to losses of the signal transmitted in the upstream direction from the users to a transmission center; and

multiplexer means to combine the signal transmitted by a transmission center with the signal transmitted by a data communication unit.

37. A home splitter unit for spliting and amplyfing a signal comprises:

divider means to split the signal modulated across the extended range of frequencies to a varied number of users; and

amplifier means to compensate for the losses in the signal due to line characteristics.

38. A home outlet unit for expanding bandwidth and filtering frequencies comprises:

bandwidth expanding means to add to the standard usable bandwidth a extended range of frequencies; and

filtering means to separate the appended extended range of frequencies to downstream and upstream pass regions.

39. In a communication network utilizing a communication media infrastructure for the transmission of a broadband signal representative of information units received from and sent to external information sources the information units encoded into modulated electronic signals the signals multiplexed into the broadband electronic signal, from a transmission center via diverse electronic components operative in the preservation of the transmitted signal vital characteristics to a plurality of users and from the plurality of users via the transmission media via the diverse electronic components operative in maintaining the functional characteristics of the transmitted broadband signal to the transmission center, a method for utilizing an expanded transmission path operative across a substantially increased range of frequencies, the method comprising:

combining the signals representative of the information received from information sources/users into a combined broadband signal modulated across a substantially expanded bandwidth;

superimposing signals representative of information units received from additional information sources connected at various locations to the transmission path onto the broadband signal modulated across the substantially expanded bandwidth; and

transmitting the combined broadband signal modulated across a substantially expanded bandwidth to a plurality of users/transmission center; and

maintaining the functional characteristics of the broadband signal modulated across a substantially expanded bandwidth during a series of processing activities performed by a set of components operatively participating in the expanded bandwidth transmission process whereby utilizing the standard transmission medium previously operating in a significantly narrower bandwidth for transmission in a substantially expanded bandwidth.

40. The method of claim 39 further comprising the step of:

dividing the broadband signal modulated across a substantially expanded bandwidth into the constituent signals representative of the information received from the information sources/users.

41. The method of claim 39 further comprising the step of:

reproducing the signals representative of the information sources for interaction with a plurality of users/external information sources.

42. The method of claim 39 wherein the step of maintaining comprises the sub steps of:

amplifying the broadband signal for overcoming line drop losses due to the network infrastructure topography;

adding gain and slope to the broadband signal in order to compensate for the losses suffered as a result of the transmission infrastructure characteristics; and

frequency-relatedly filtering the broadband signal to separate the signal according to predefined transmission regions and by predefined parameters relating to the content type and the direction of the broadband signal; and

frequency-relatedly tuning the broadband signal to control the division of the signal into predefined frequency regions within the substantially expanded bandwidth.

43. The method of claim 39 wherein the step of superimposing comprises the sub-steps of:

receiving/transmitting the signals representative of the information units from/ to additional information sources/users;

processing the signals representative of the information units received/transmitted from/to additional information sources/users to determine the location of the signals in regard to a predefined frequency band with the substantially expanded transmission bandwidth; and

modulating/demodulating the signals received/transmitted from/to the additional information sources/users; and

routing the signals representative of the information units received/transmitted from/to the additional information sources/users to the suitable processing unit and to the suitably oriented network components.

44. The method of claim 40 wherein the step of dividing comprises the step of:

splitting the broadband signal modulated across the substantially expanded bandwidth in order to distribute the separated signal elements to a predefined group of users.

45. The method of claim 41 wherein the step of reproducing comprises the step of:

filtering the broadband signal to separate the extended range of frequencies from the standard range of frequencies; and

separating the broadband signal to isolate the extended range of frequencies into a downstream and upstream region; and

modulating/demodulating the signal to decode/encode the information carried by the signal in order to reproduce the signal for interaction with the information sources/users.

46. The method of claim 39 wherein the communication network is a cable television system carrying video, audio and data information units and any combination thereof to a plurality of users utilizing a plurality of transmission channels.

47. A two-way multi-user transmission and communication system having the capability of utilizing a substantially expanded range of frequencies in order to transmit a significantly increased quantity of information units encoded into electronic signals and inserted into a transmittable broadband signal at frequency-related locations the broadband signal having prior transmittable information multiplexed therein without affecting the simultaneous transmission of the existing transmittable information to a plurality of users in response to the users' corresponding demands, the system comprising:

a compensation unit including downstream and upstream amplifying units in order to amplify the broadband signal;

a home outlet splitter unit including a signal divider to distribute the split broadband signal modulated across a substantially expanded range of frequencies among a predefined group of users;

a home outlet unit including filtering components having the capability of handling an expanded range of frequencies in order to separate the broadband signal into predefined range of and to suitable manipulate the broadband signal elements inserted into the significantly expanded bandwidth region; and

an extension unit to a set-top box interfacing with a terminal or any other communication device including tuner components to control the additional channels combined within the expanded region of the frequency bandwidth, filtering components to separate the diverse frequency regions, modulators, and demodulators to decode the signal in order the enable the user to interact with the various elements of the signal and to encode the information resulted from the users request into the upstream region of the broadband signal; and

an enhanced cable connector assembly to provide for the downstream and upstream transmission of the signals having the proper spectral response characteristics.

48. The system of claim 47 further comprising a data communication unit including data routers, modulators, demodulators and a CPU to receive/transmit signals representing information units and insert the signals into the broadband signal for downstream or upstream transmission.

49. The system of claim 47 further comprising a hub station unit including amplifiers to compensate for the losses of the broadband signals as a result of the transmission media characteristics, and multiplexer components to superimpose additional signals received from additional information sources into the broadband signal.

50. The system of claim 47 wherein the size of the substantially expanded usable frequency range region is about 3000 Mhz.

51. The system of claim 47 wherein the range of the substantially expanded usable bandwidth is about 5-3000 Mhz.

52. The system of claim 47 wherein the substantially expanded transmission bandwidth includes an about 5-35 Mhz region for the standard upstream transmission band.

53. The system of claim 47 wherein the substantially expanded usable bandwidth includes an about 50-750 Mhz region utilized as the standard downstream transmission band for the existing transmittable channels.

54. The system of claim 47 wherein the extended frequency band of about 1000-3000 Mhz is allocated among a plurality of channels.

55. The system of claim 47 wherein the plurality of channels carry encoded signals superimposed on the broadband signal representing the entirety of the transmitted information.

56. The system of claim 47 wherein in symmetrical operation mode the extended frequency range of about 1000-3000 Mhz is divided into a downstream and upstream path each having a range of about 1000 Mhz.

57. The system of claim 47 wherein the additional external information source is a data communication network.

58. The system of claim 47 wherein the data communication network is the Internet.

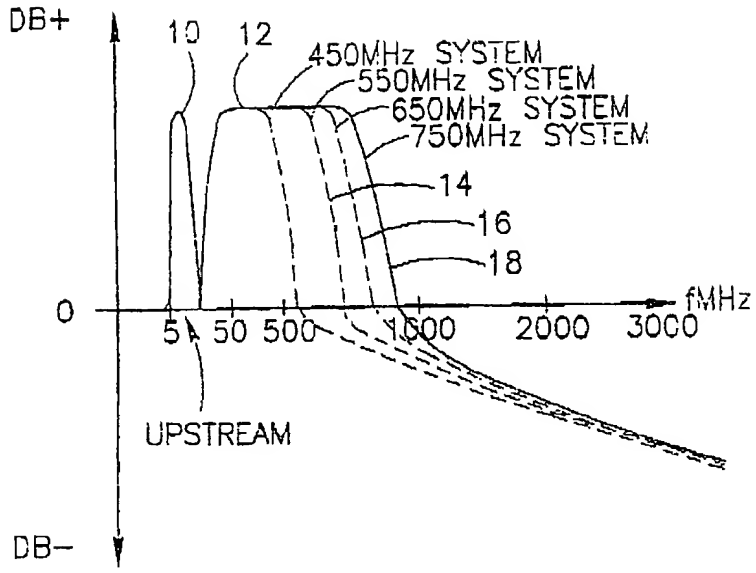
DB+
10
12
450MHz SYSTEM
550MHz SYSTEM
650MHz SYSTEM
750MHz SYSTEM
14
16
18
0
fMHz
5
50
500
1000
2000
3000
UPSTREAM
DB−

FIG.1A

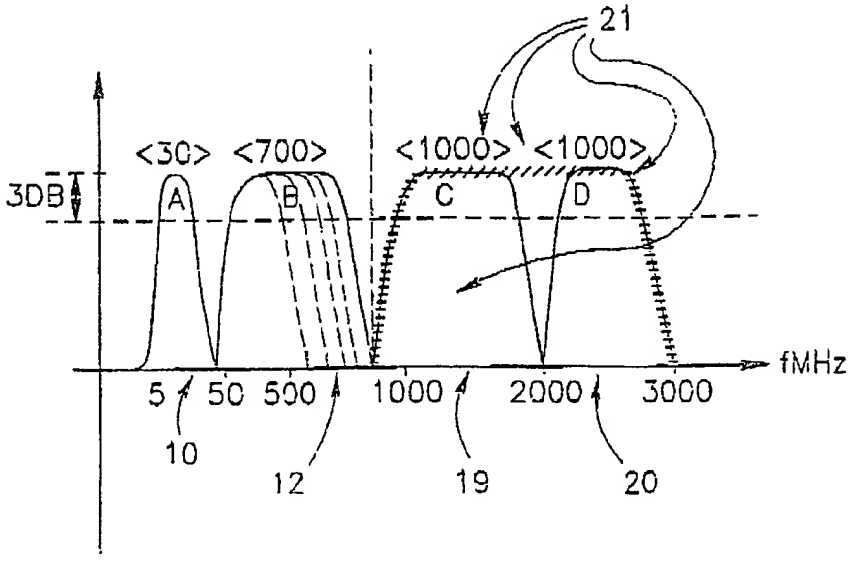
21
<30>
<700>
<1000>
<1000>
3DB
A
B
C
D
fMHz
5
50
500
1000
2000
3000
10
12
19
20

FIG.1B

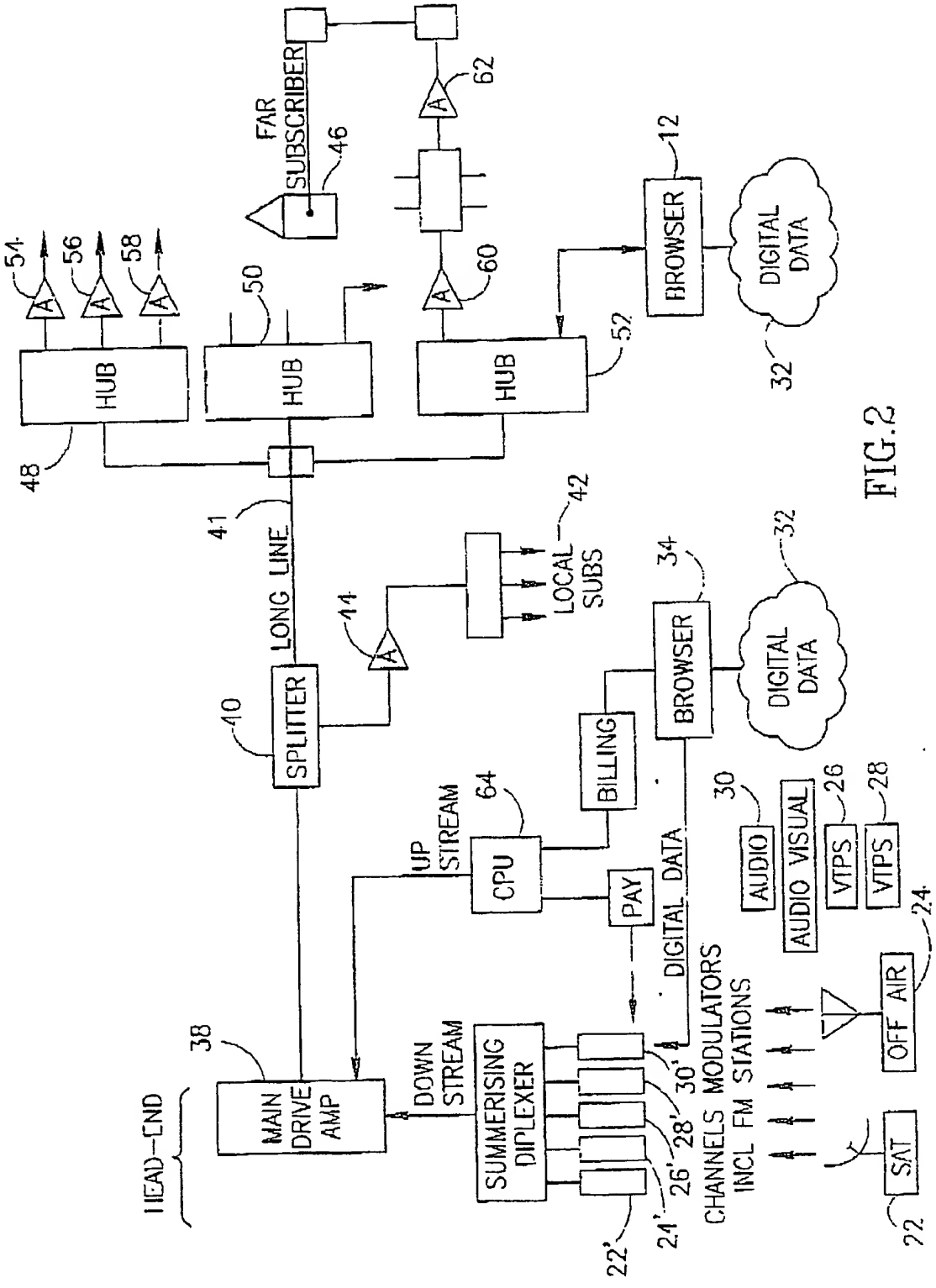
HEAD-END
MAIN DRIVE AMP
38
DOWN STREAM
SUMMERISING DIPLEXER
22'
24'
26'
28'
30'
CHANNELS MODULATORS INCL FM STATIONS
SAT
22
OFF AIR
24
AUDIO
AUDIO VISUAL
VTPS
VTPS
26
28
30
DIGITAL DATA
PAY
UP STREAM
CPU
64
BILLING
BROWSER
34
DIGITAL DATA
32
SPLITTER
10
LONG LINE
41
LOCAL SUBS
42
14
HUB
48
HUB
50
HUB
52
54
56
58
60
62
FAR SUBSCRIBER
46
BROWSER
12
DIGITAL DATA
32

FIG.2

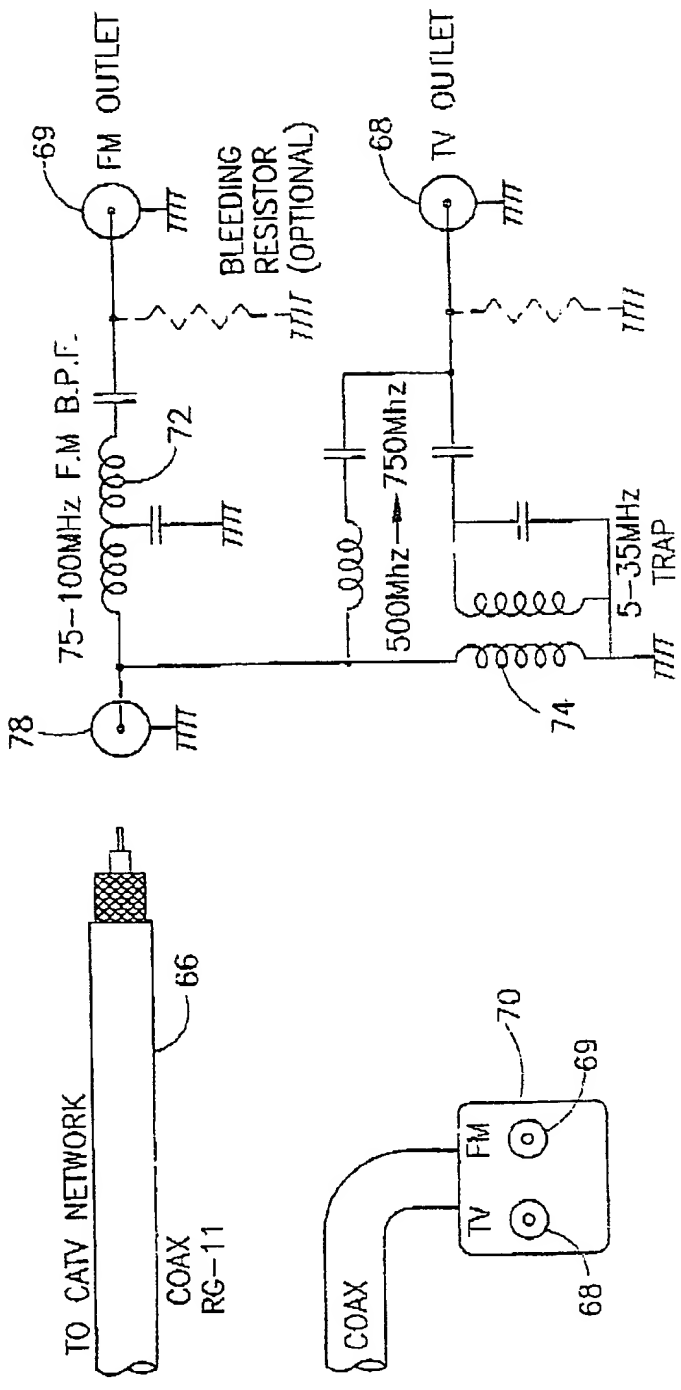
FM OUTLET
69
BLEEDING RESISTOR (OPTIONAL)
TV OUTLET
68
75-100MHz F.M B.P.F.
72
500Mhz — 750Mhz
5-35MHz TRAP
78
74
TO CATV NETWORK
66
COAX RG-11
COAX
FM
TV
70
69
68

FIG.3

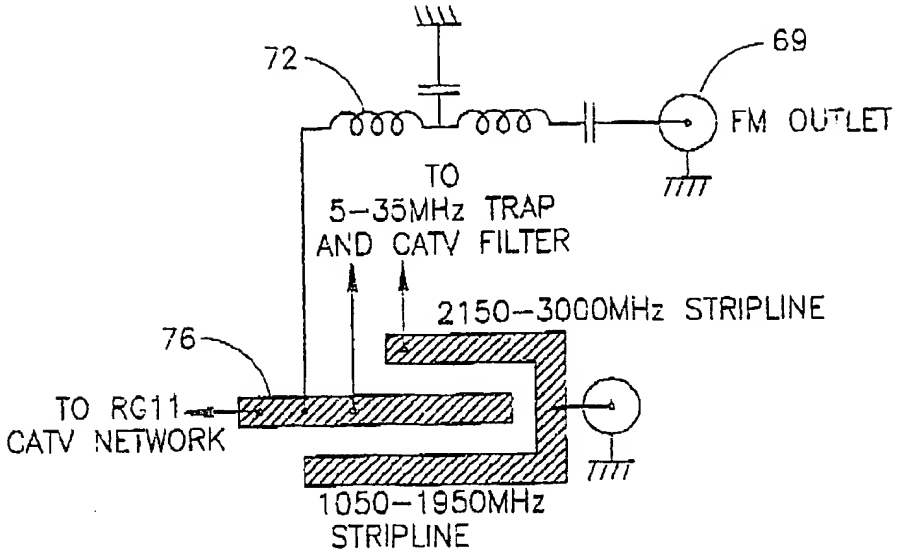
72
69
FM OUTLET
TO
5-35MHz TRAP
AND CATV FILTER
2150-3000MHz STRIPLINE
76
TO RG11
CATV NETWORK
1050-1950MHz
STRIPLINE

FIG.4

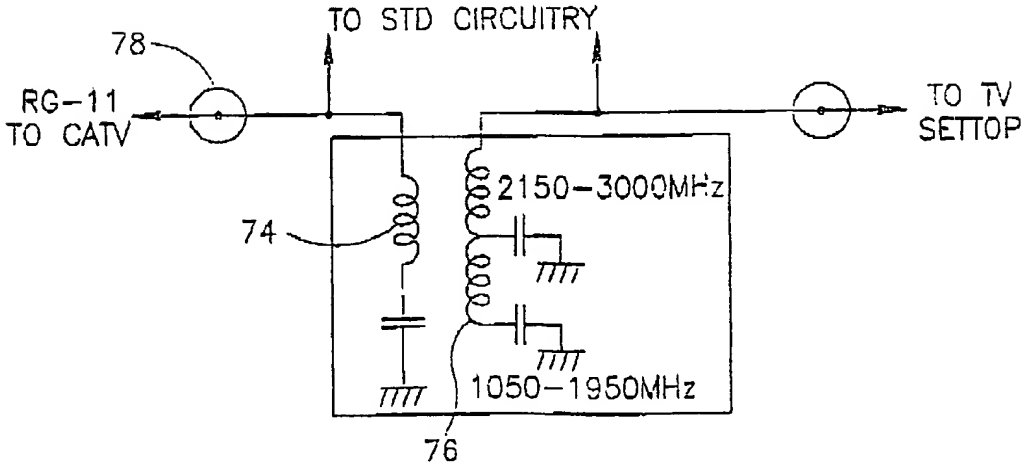
TO STD CIRCUITRY
78
RG-11
TO CATV
TO TV
SETTOP
2150-3000MHz
74
1050-1950MHz
76

FIG.5

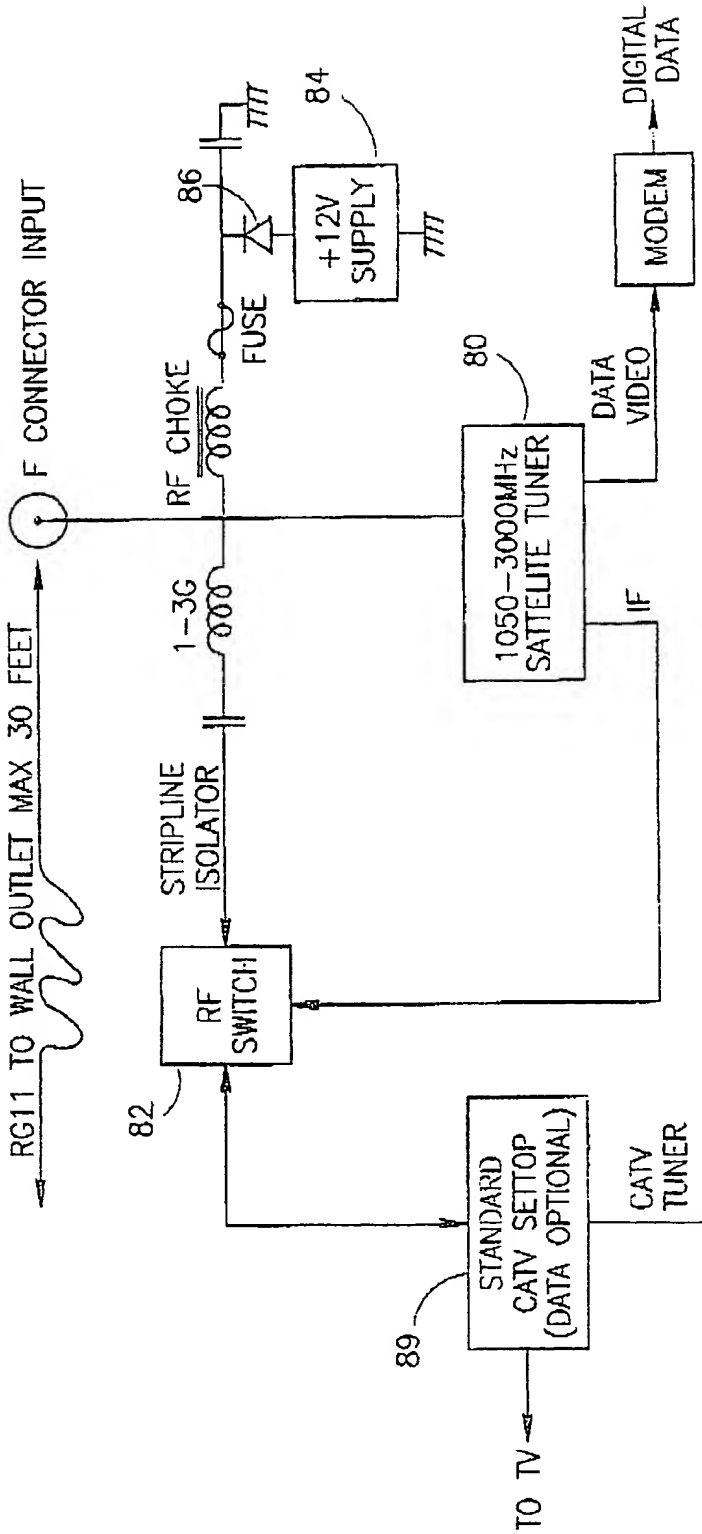
F CONNECTOR INPUT
RG11 TO WALL OUTLET MAX 30 FEET
RF CHOKE
FUSE
86
84
+12V SUPPLY
1-3G
STRIPLINE ISOLATOR
82
RF SWITCH
80
1050-3000MHz SATTELITE TUNER
DATA VIDEO
IF
MODEM
DIGITAL DATA
STANDARD CATV SETTOP (DATA OPTIONAL)
89
CATV TUNER
DIGITAL DATA (IF PRESENT)
TO TV

FIG.6

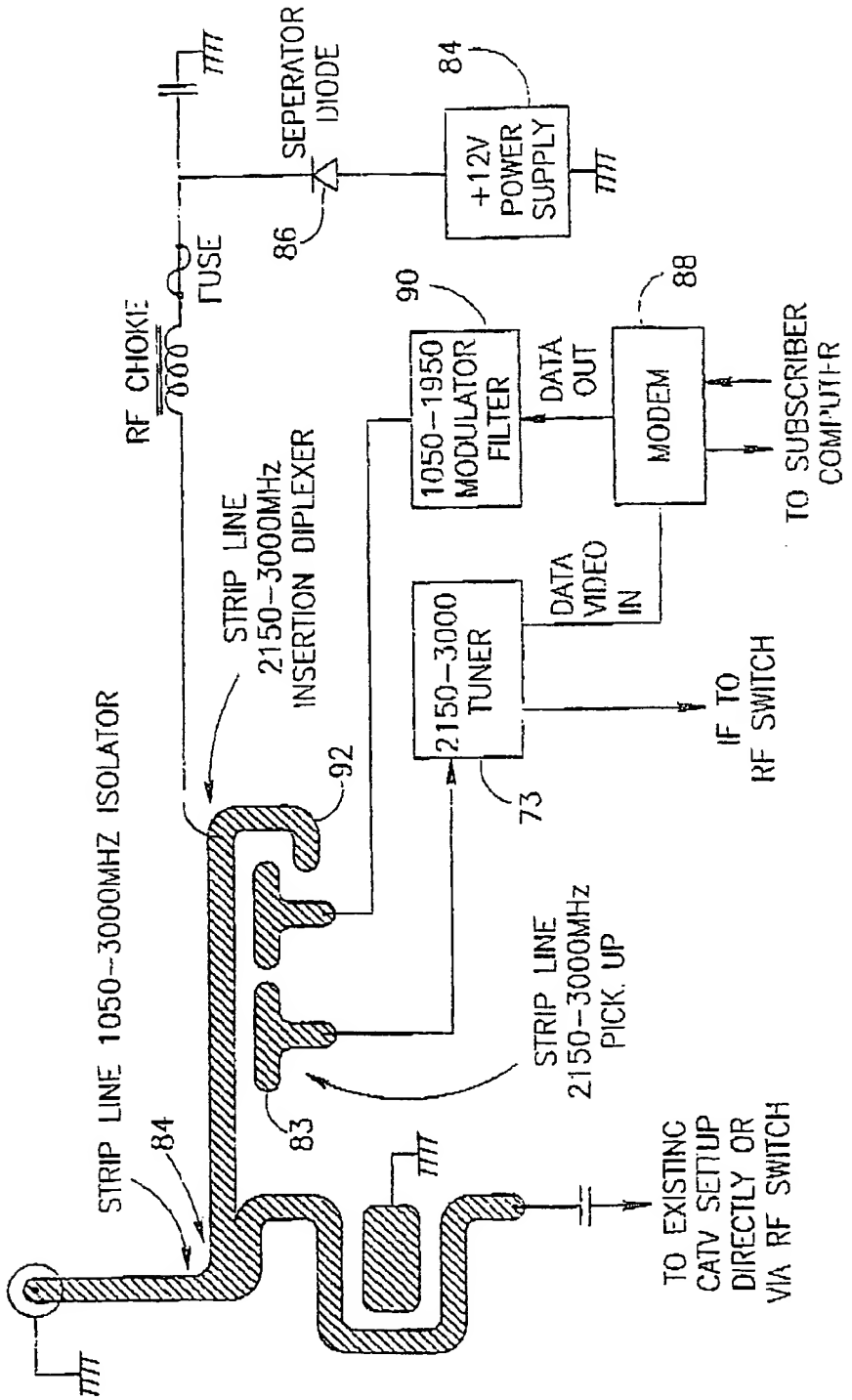
STRIP LINE 1050-3000MHZ ISOLATOR
84
83
STRIP LINE
2150-3000MHz
PICK UP
TO EXISTING
CATV SETUP
DIRECTLY OR
VIA RF SWITCH
STRIP LINE
2150-3000MHz
INSERTION DIPLEXER
92
RF CHOKE
FUSE
SEPERATOR
DIODE
86
+12V
POWER
SUPPLY
84
2150-3000
TUNER
73
1050-1950
MODULATOR
FILTER
90
DATA
OUT
MODEM
88
DATA
VIDEO
IN
IF TO
RF SWITCH
TO SUBSCRIBER
COMPUTER

FIG.7

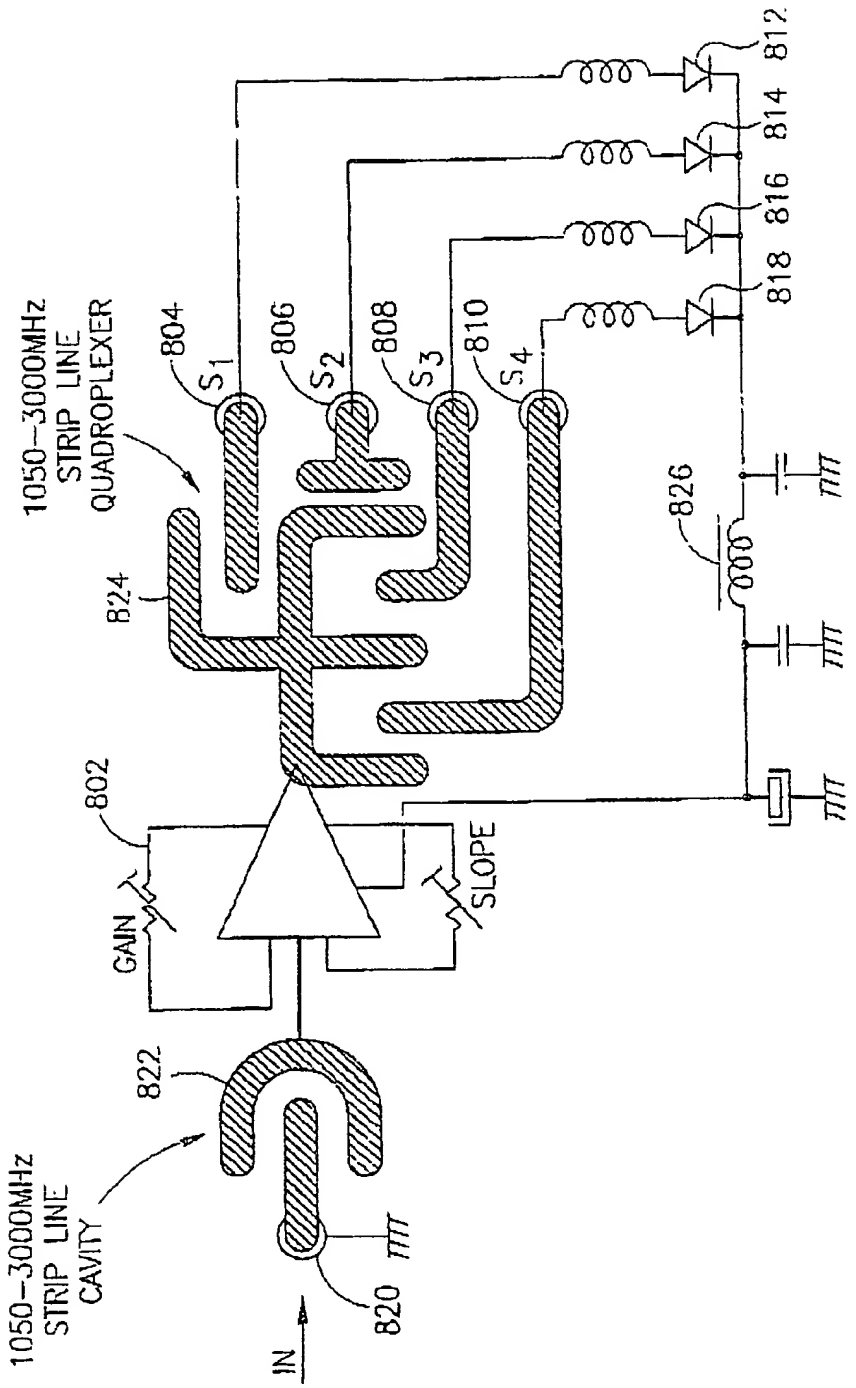
1050–3000MHz
STRIP LINE
QUADROPLEXER
1050–3000MHz
STRIP LINE
CAVITY
IN
820
822
824
802
GAIN
SLOPE
804
806
808
810
812
814
816
818
826

FIG.8

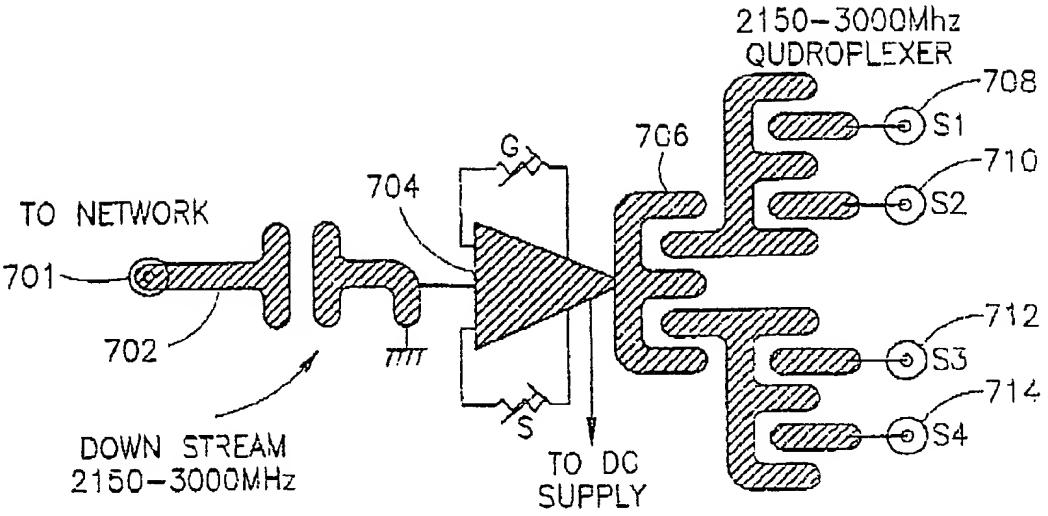
2150-3000Mhz
QUDROPLEXER
708
S1
710
S2
712
S3
714
S4
706
G
704
TO NETWORK
701
702
S
DOWN STREAM
2150-3000MHz
TO DC
SUPPLY

FIG.9A

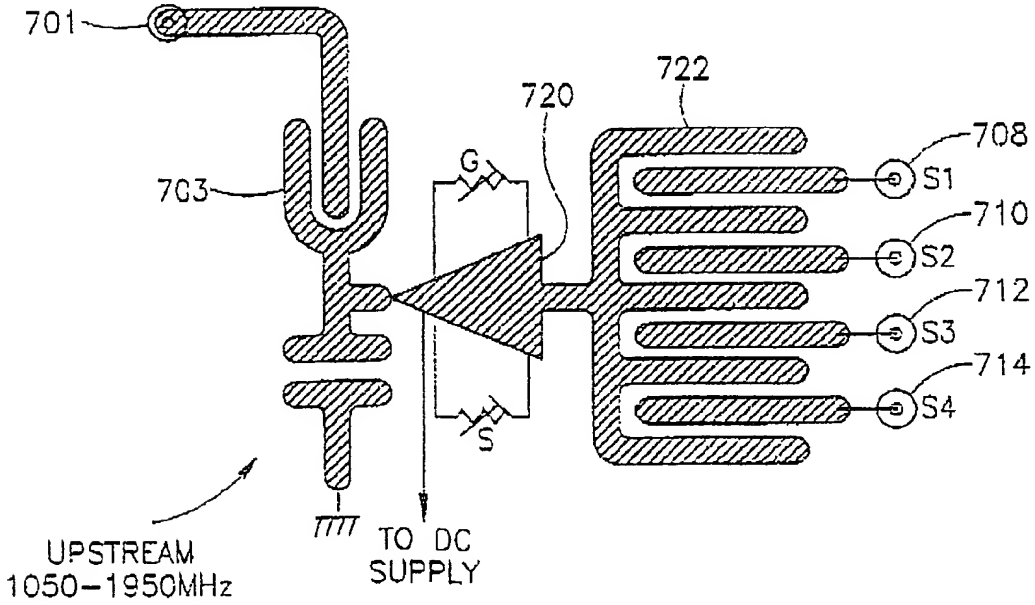
701
722
720
708
S1
703
G
710
S2
712
S3
714
S4
S
UPSTREAM
1050-1950MHz
TO DC
SUPPLY

FIG.9B

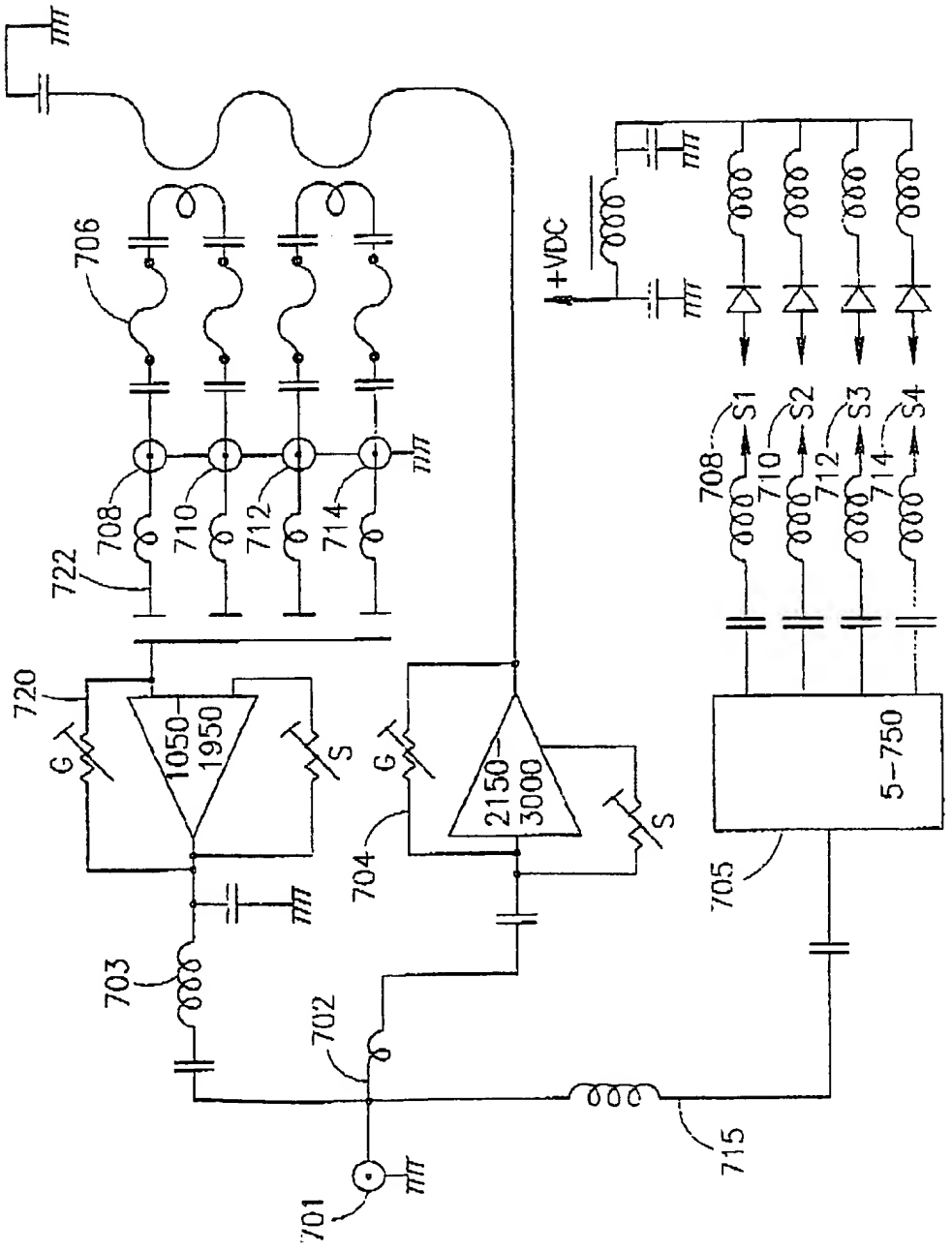
706
708
710
712
714
722
720
G
1050
1950
S
703
704
G
2150
3000
S
702
701
+VDC
S1
S2
S3
S4
708
710
712
714
5-750
705
715

FIG.9C

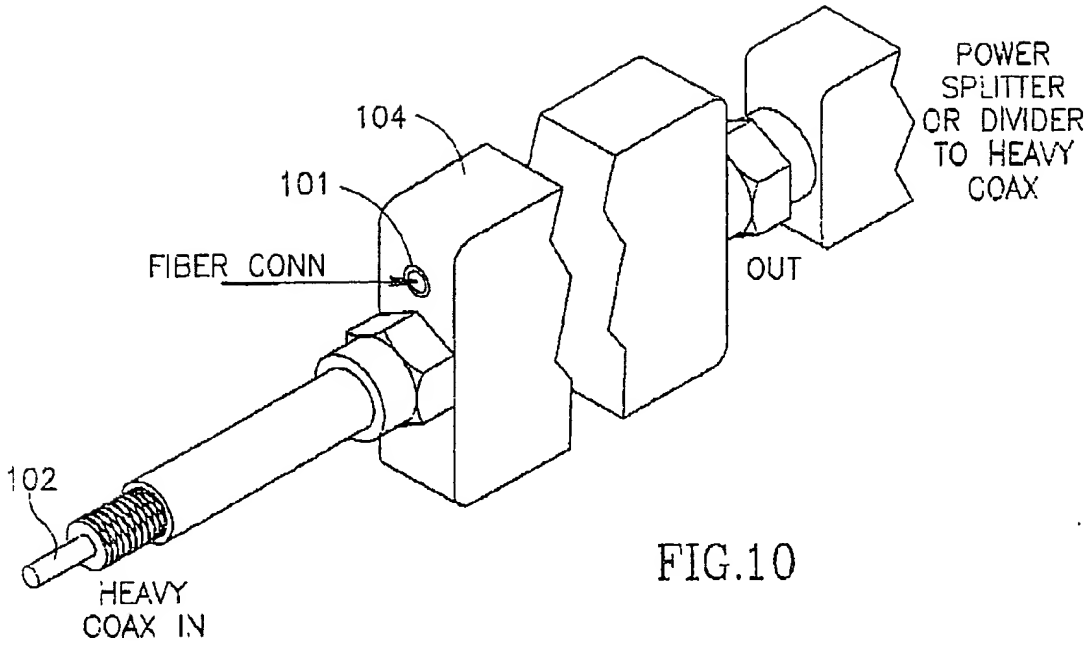
POWER
SPLITTER
OR DIVIDER
TO HEAVY
COAX
104
101
FIBER CONN
OUT
102
HEAVY
COAX IN

FIG.10

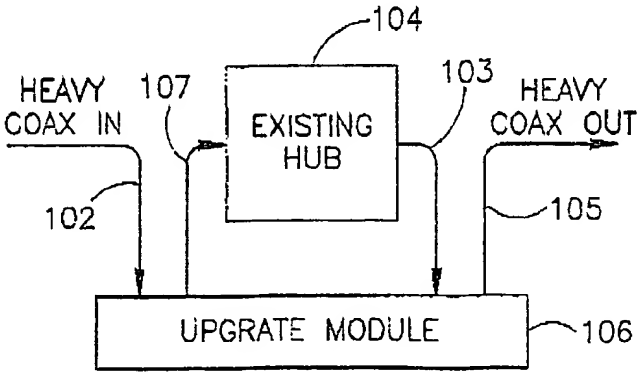
104
HEAVY
COAX IN
107
EXISTING
HUB
103
HEAVY
COAX OUT
102
105
UPGRATE MODULE
106

FIG.11

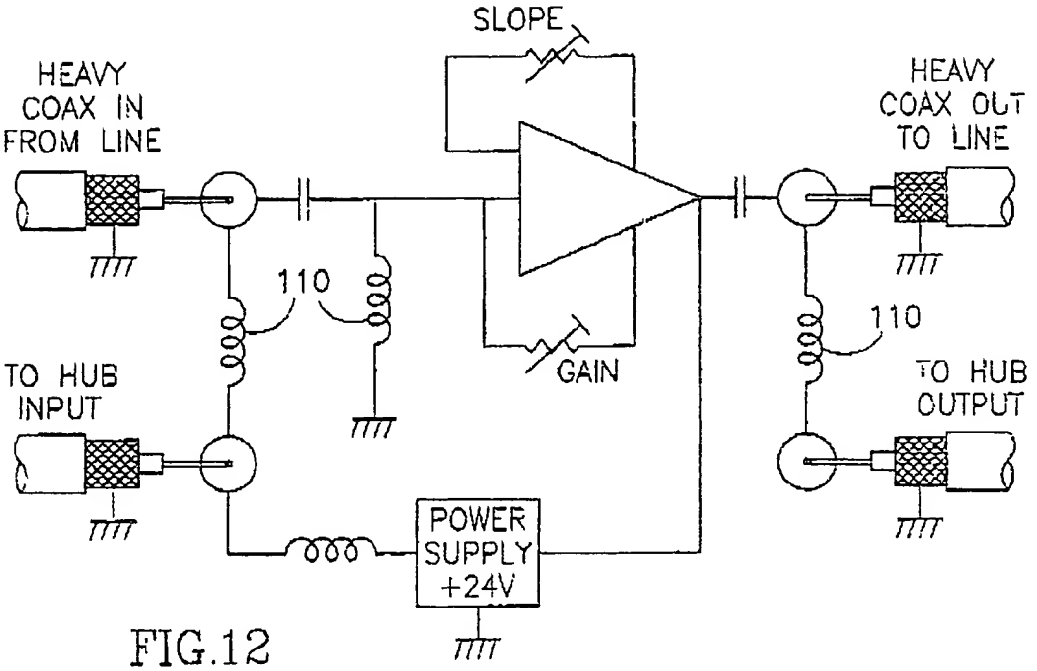
SLOPE
HEAVY COAX IN FROM LINE
HEAVY COAX OUT TO LINE
110
110
GAIN
TO HUB INPUT
TO HUB OUTPUT
POWER SUPPLY +24V

FIG.12

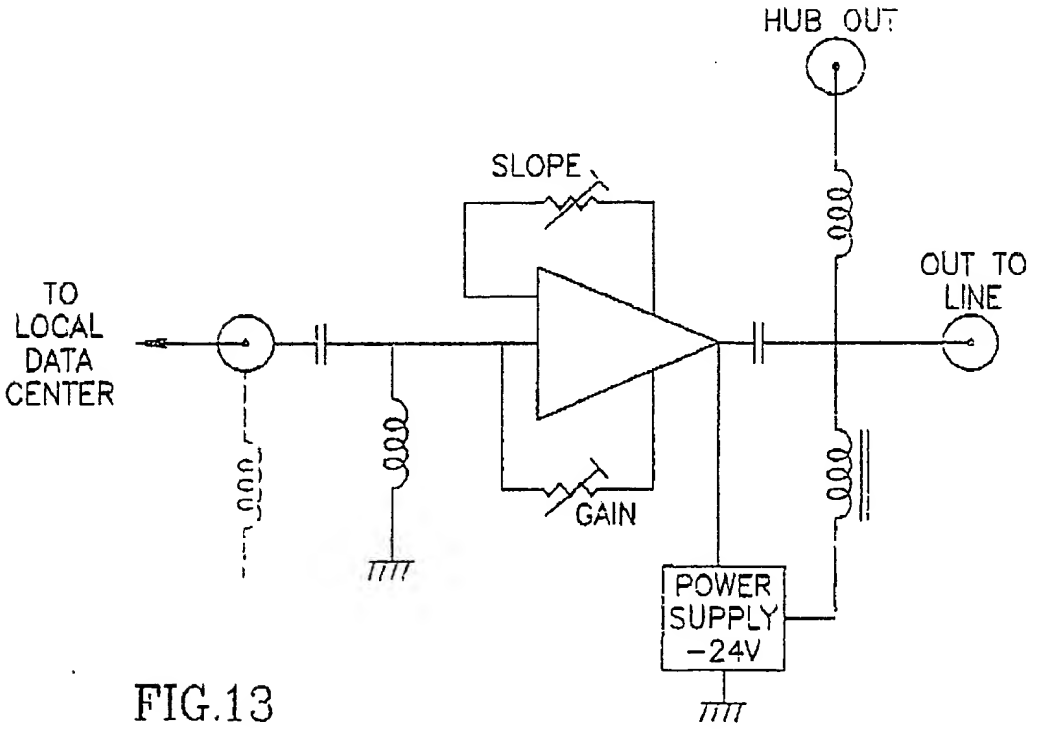
HUB OUT
SLOPE
TO LOCAL DATA CENTER
OUT TO LINE
GAIN
POWER SUPPLY -24V

FIG.13

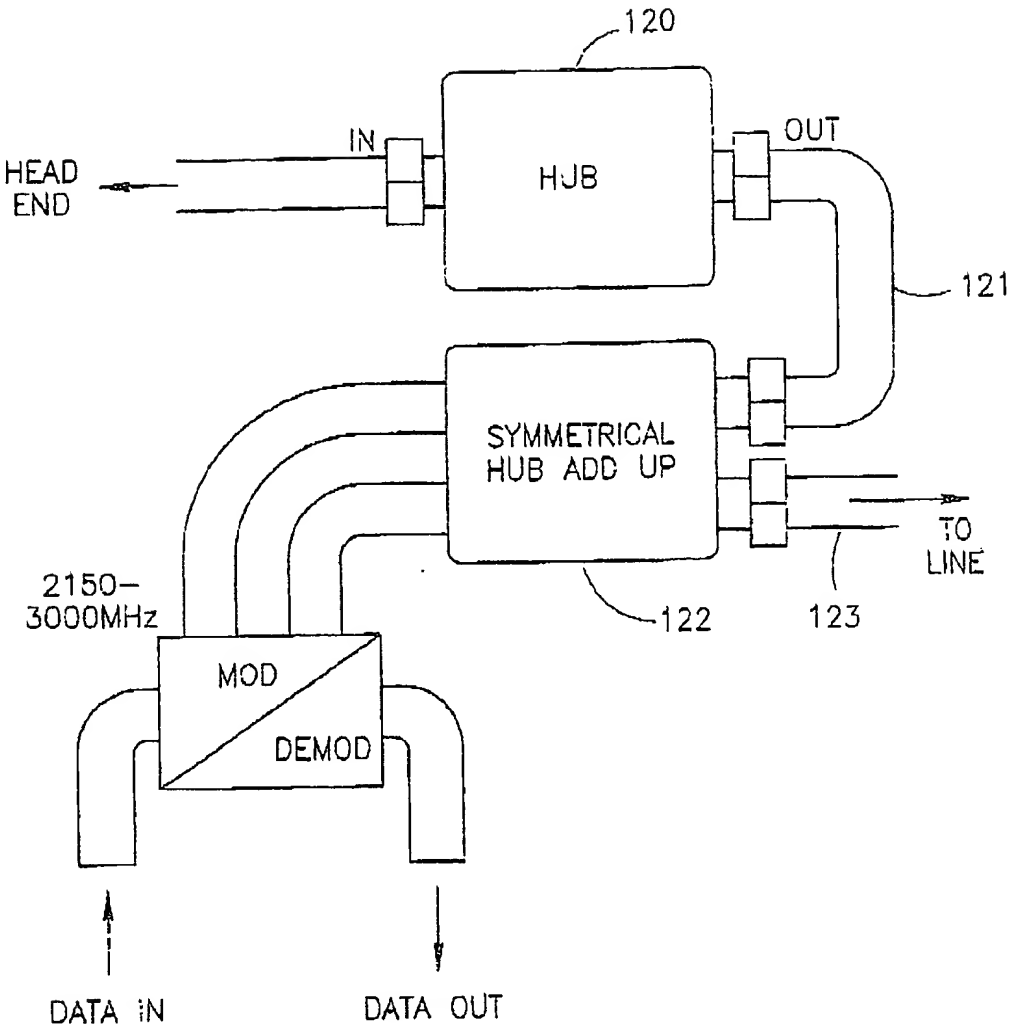
120
IN
OUT
HEAD
END
HUB
121
SYMMETRICAL
HUB ADD UP
TO
LINE
2150–
3000MHz
MOD
DEMOD
122
123
DATA IN
DATA OUT

FIG.14

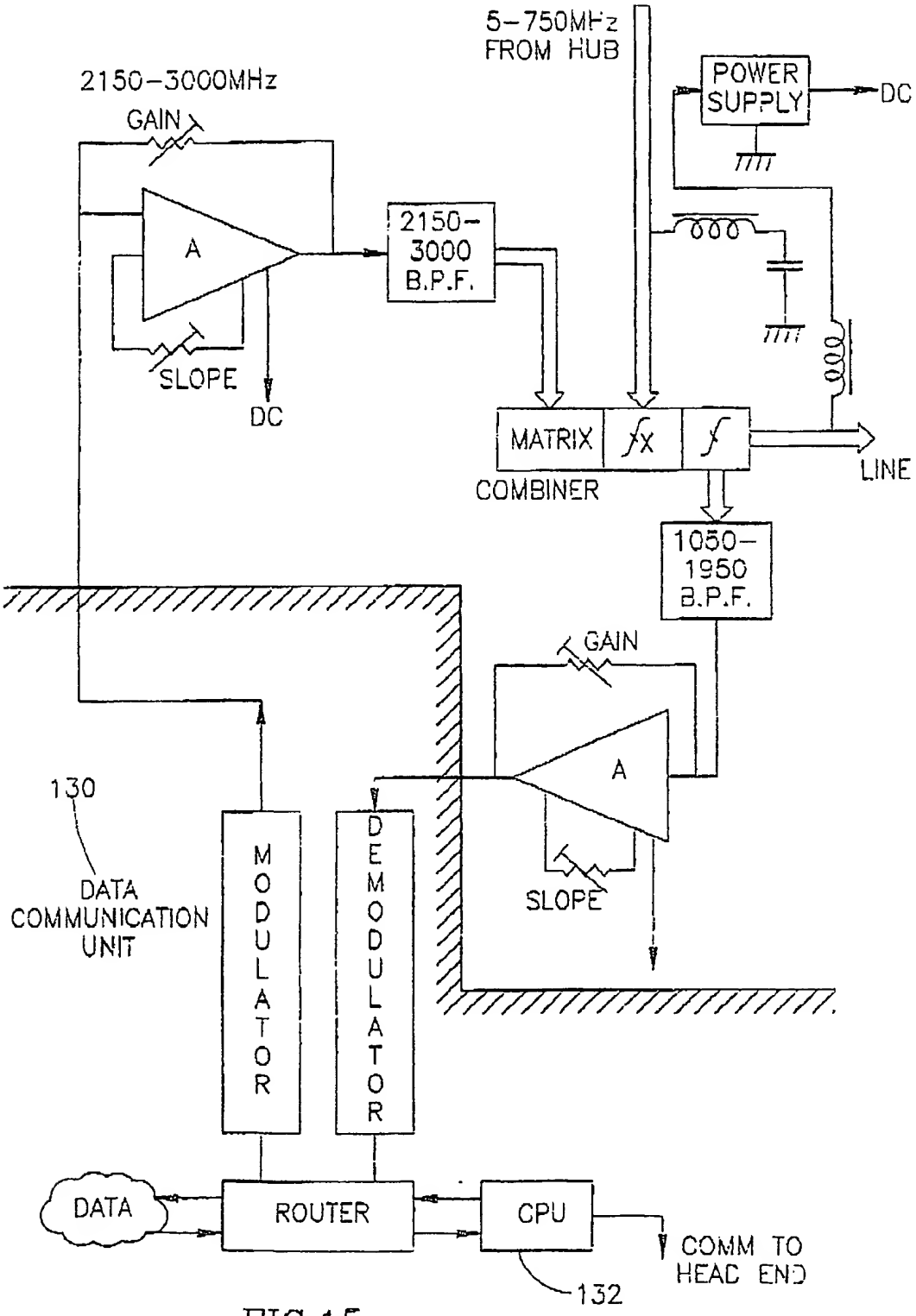
5-750MHz
FROM HUB
2150-3000MHz
GAIN
A
SLOPE
DC
2150-
3000
B.P.F.
POWER
SUPPLY
DC
MATRIX
fx
f
COMBINER
LINE
1050-
1950
B.P.F.
GAIN
A
SLOPE
130
DATA
COMMUNICATION
UNIT
MODULATOR
DEMODULATOR
DATA
ROUTER
CPU
COMM TO
HEAD END
132

FIG.15

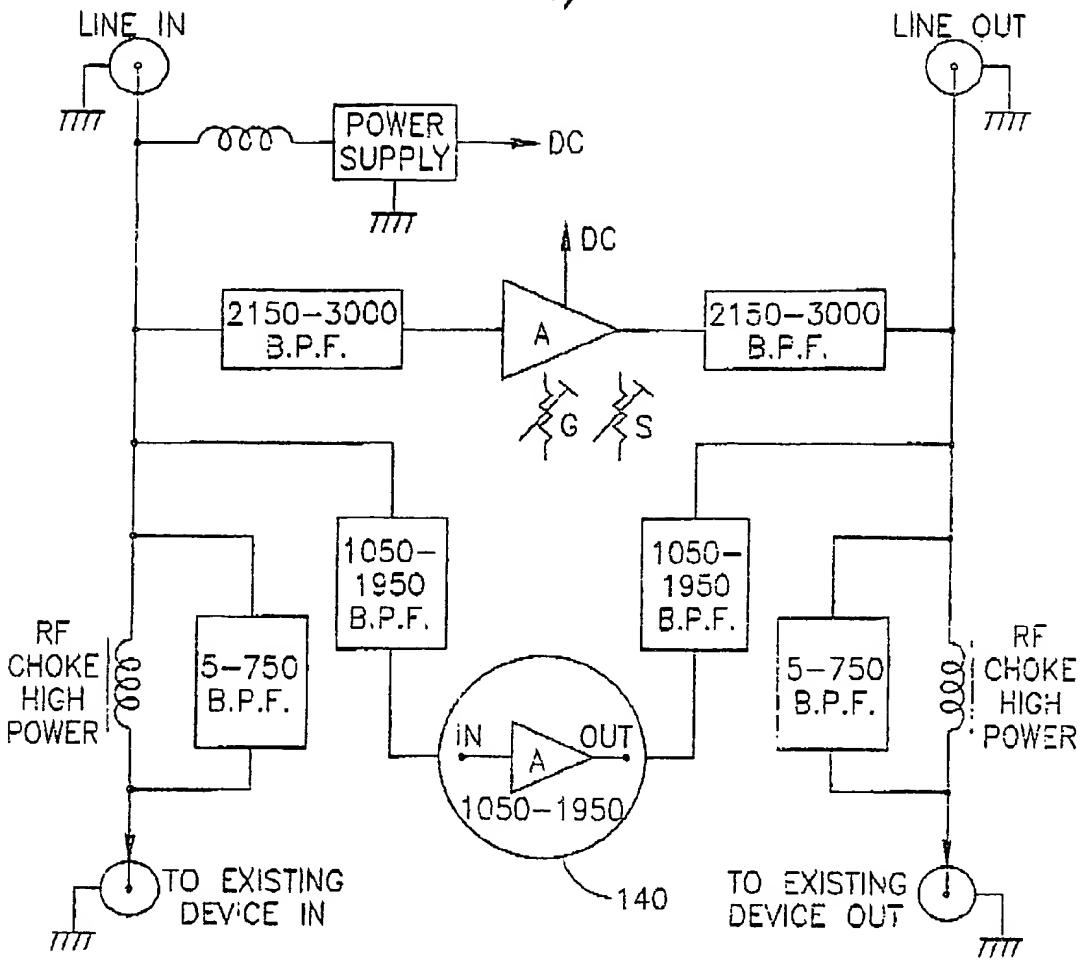
LINE IN
LINE OUT
POWER SUPPLY
DC
DC
2150-3000 B.P.F.
A
2150-3000 B.P.F.
G
S
1050-1950 B.P.F.
1050-1950 B.P.F.
RF CHOKE HIGH POWER
5-750 B.P.F.
5-750 B.P.F.
RF CHOKE HIGH POWER
IN
OUT
A
1050-1950
140
TO EXISTING DEVICE IN
TO EXISTING DEVICE OUT

FIG.16

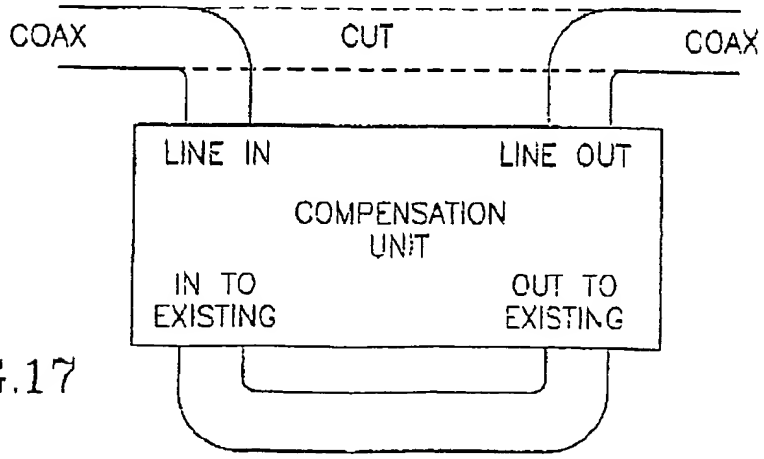
COAX
CUT
COAX
LINE IN
LINE OUT
COMPENSATION UNIT
IN TO EXISTING
OUT TO EXISTING

FIG.17

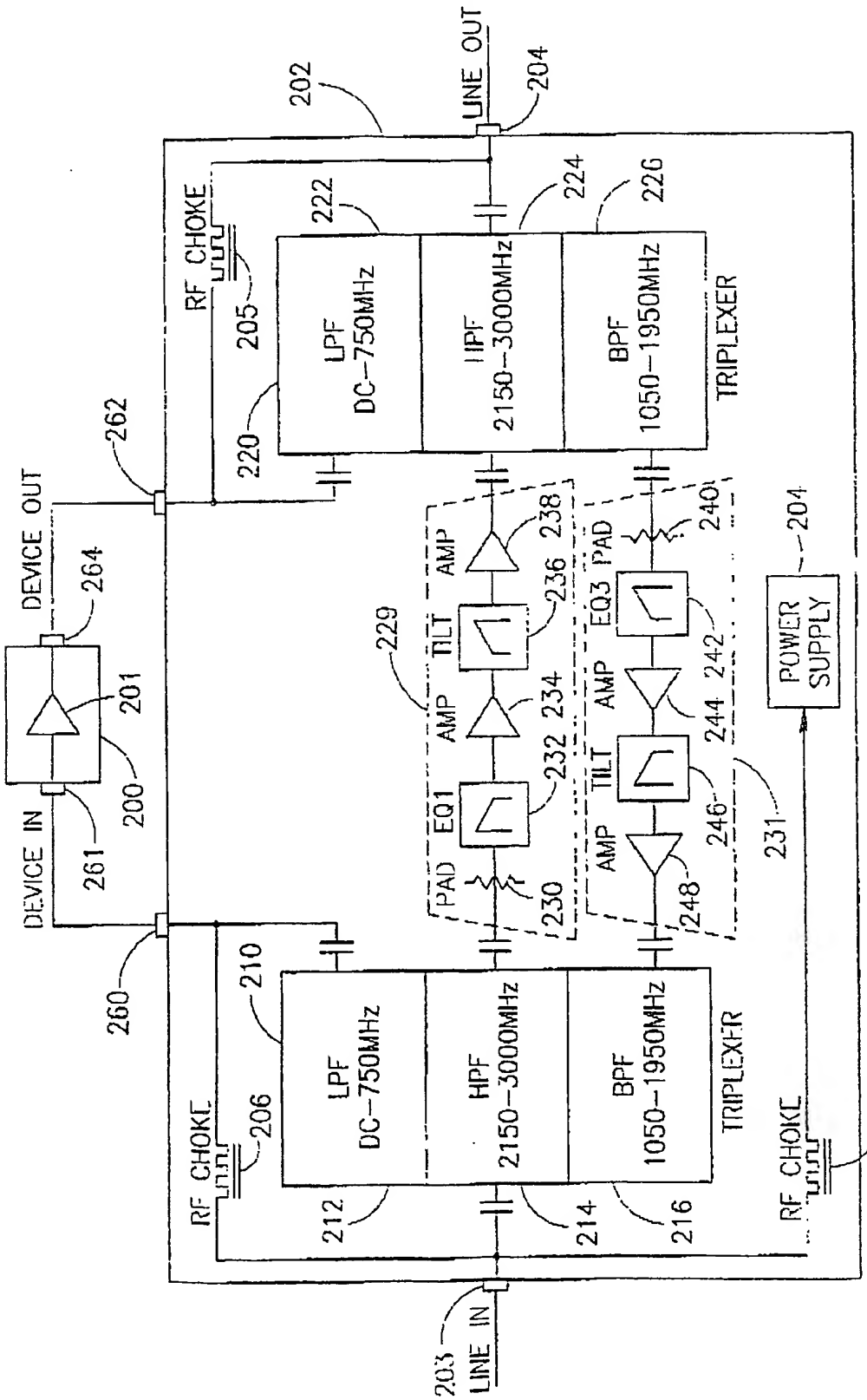
LINE OUT
202
204
RF CHOKE
205
LPF
DC-750MHz
222
HPF
2150-3000MHz
224
BPF
1050-1950MHz
226
TRIPLEXER
220
DEVICE OUT
262
264
DEVICE IN
261
201
200
260
229
TILT AMP
238
236
EQ3 PAD
240
POWER SUPPLY
204
AMP
234
232
TILT AMP
242
244
PAD EQ1
230
AMP
246
248
231
RF CHOKE
206
LPF
DC-750MHz
210
HPF
2150-3000MHz
BPF
1050-1950MHz
TRIPLEXER
212
214
216
RF CHOKE
208
LINE IN
203

FIG.18

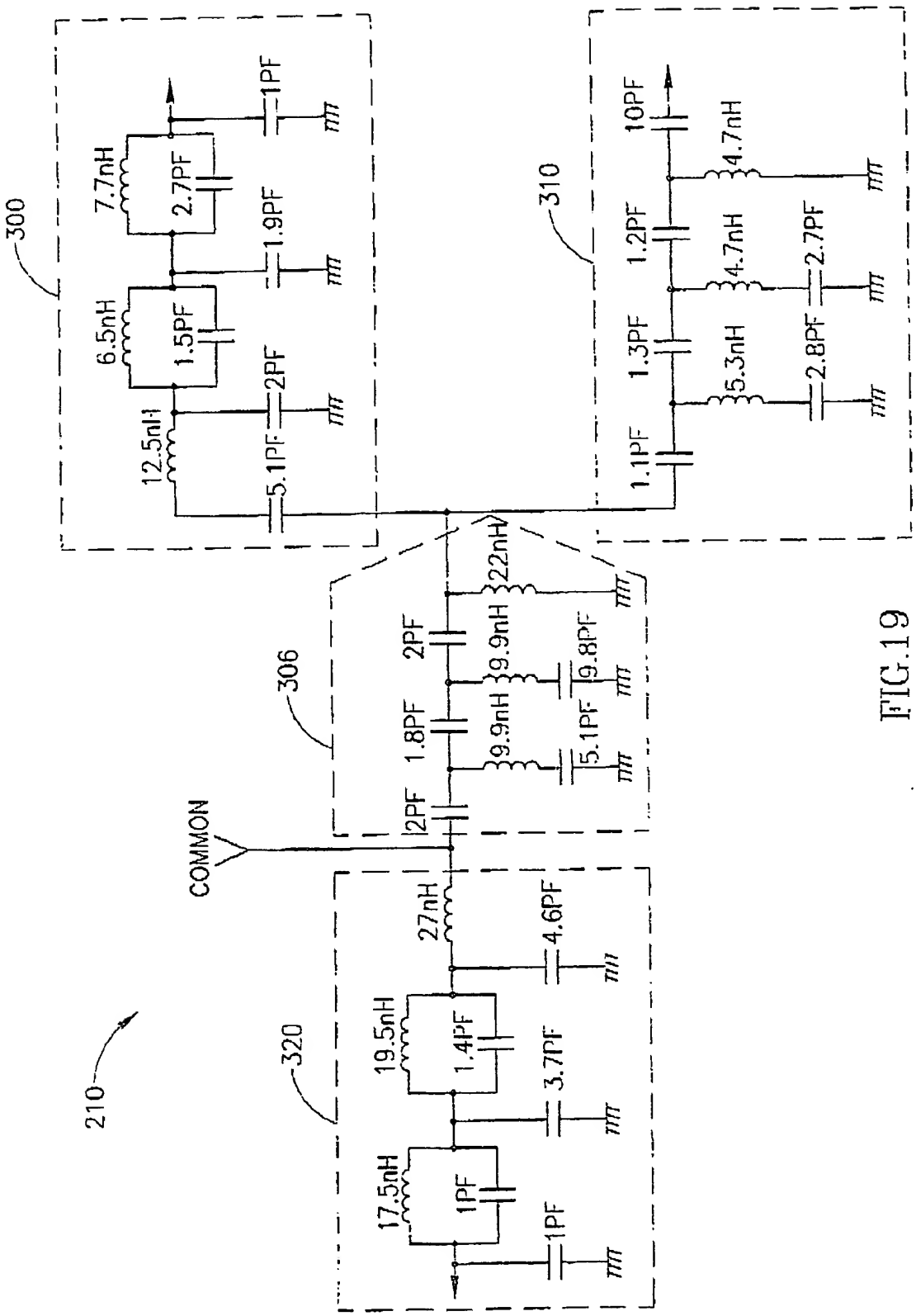
210
COMMON
300
310
306
320
12.5nH
6.5nH
7.7nH
5.1PF
2PF
1.5PF
2.7PF
1.9PF
1PF
1.1PF
1.3PF
5.3nH
1.2PF
4.7nH
2.8PF
2.7PF
10PF
4.7nH
2PF
1.8PF
9.9nH
9.9nH
5.1PF
9.8PF
22nH
27nH
4.6PF
19.5nH
1.4PF
3.7PF
17.5nH
1PF
1PF

FIG.19

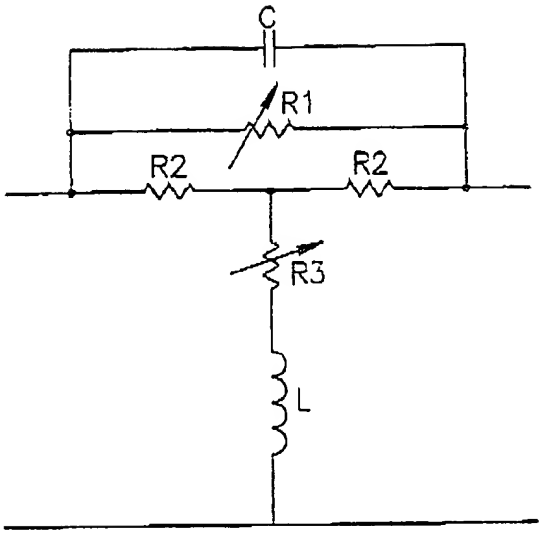

FIG.20

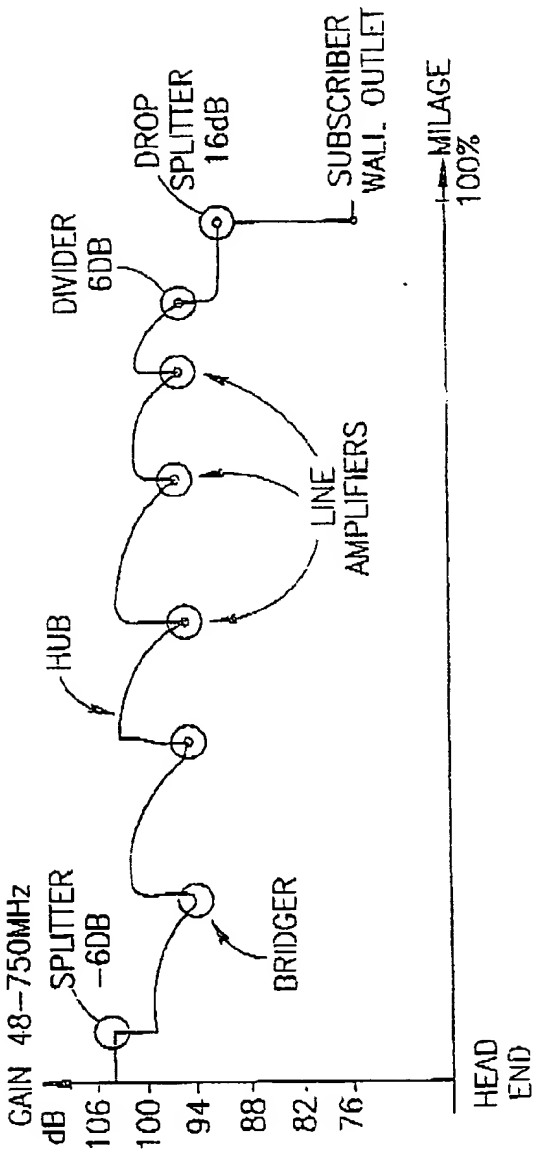
GAIN 48–750MHz
dB
106
100
94
88
82
76
SPLITTER
–6DB
BRIDGER
HUB
LINE
AMPLIFIERS
DIVIDER
6DB
DROP
SPLITTER
16dB
SUBSCRIBER
WALL OUTLET
MILAGE
100%
HEAD
END

FIG.21

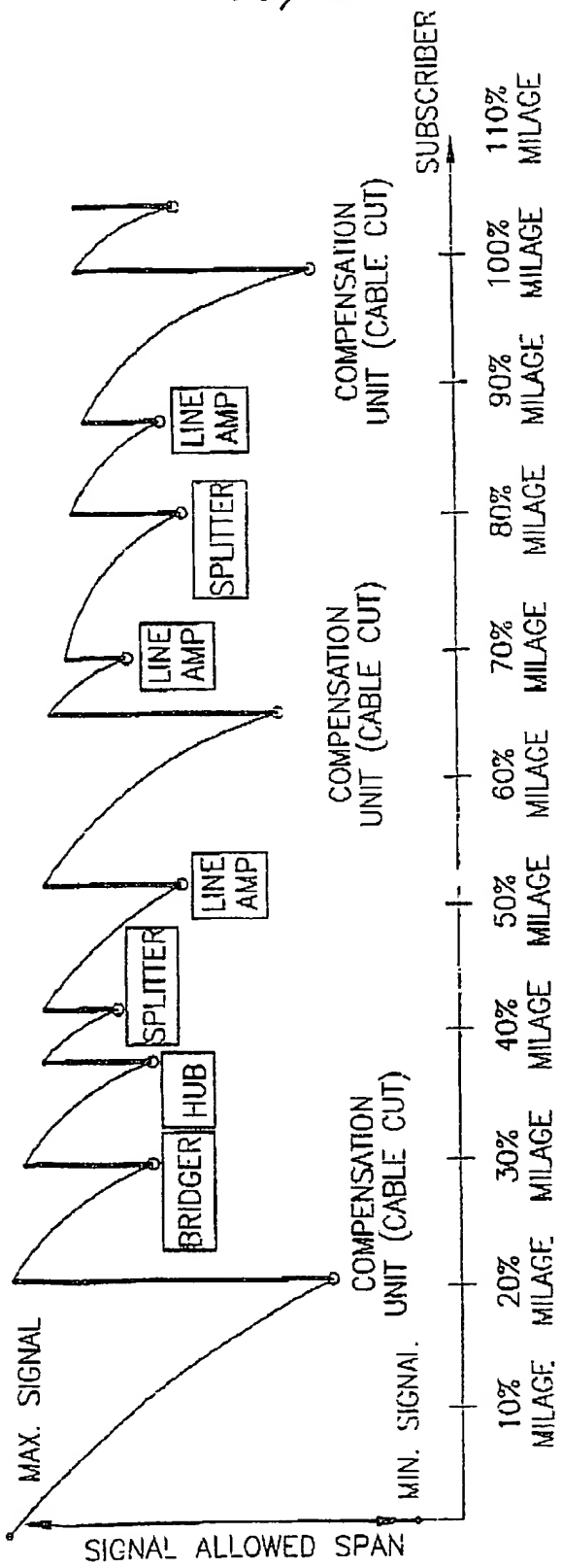
MAX. SIGNAL
MIN. SIGNAL
SIGNAL ALLOWED SPAN
BRIDGER
HUB
SPLITTER
LINE AMP
SPLITTER
LINE AMP
LINE AMP
COMPENSATION UNIT (CABLE CUT)
COMPENSATION UNIT (CABLE CUT)
COMPENSATION UNIT (CABLE CUT)
SUBSCRIBER
10% MILAGE
20% MILAGE
30% MILAGE
40% MILAGE
50% MILAGE
60% MILAGE
70% MILAGE
80% MILAGE
90% MILAGE
100% MILAGE
110% MILAGE

FIG.22

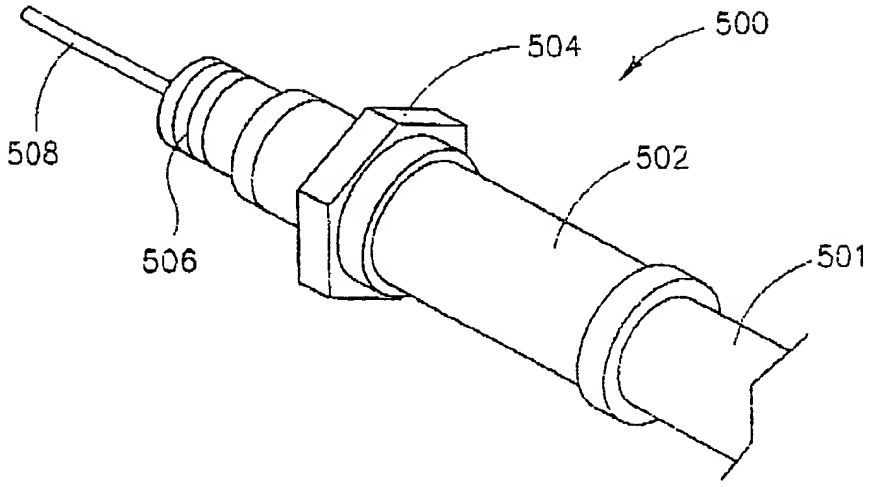

FIG.23

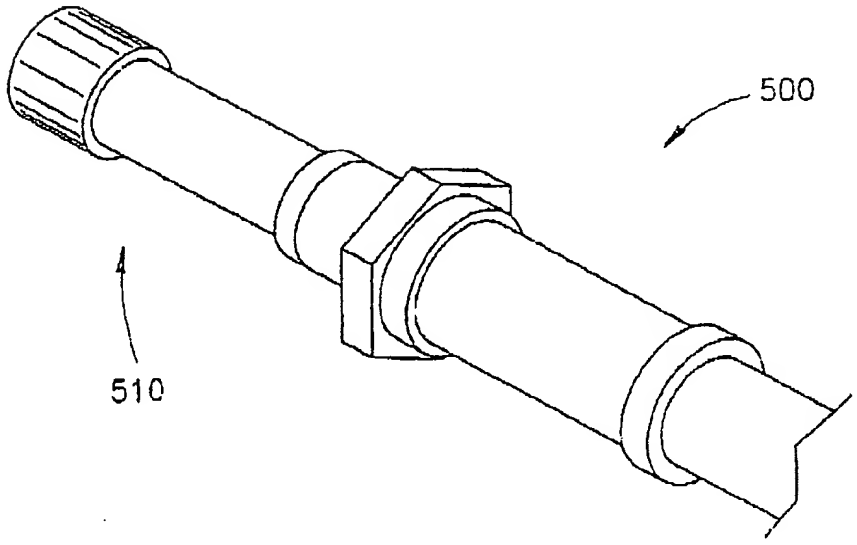

FIG.24

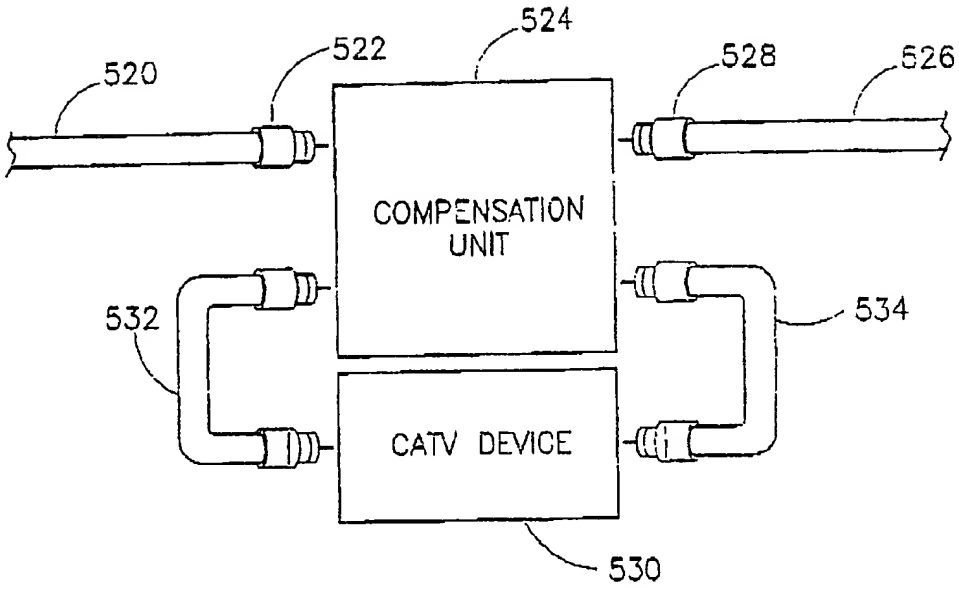
520
522
524
528
526
COMPENSATION UNIT
532
534
CATV DEVICE
530

FIG.25

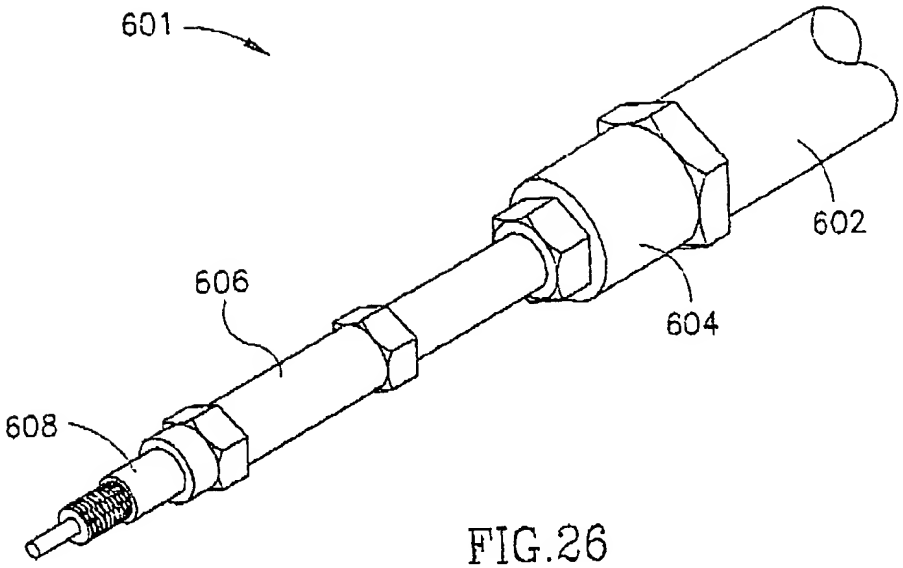
601
602
604
606
608

FIG.26

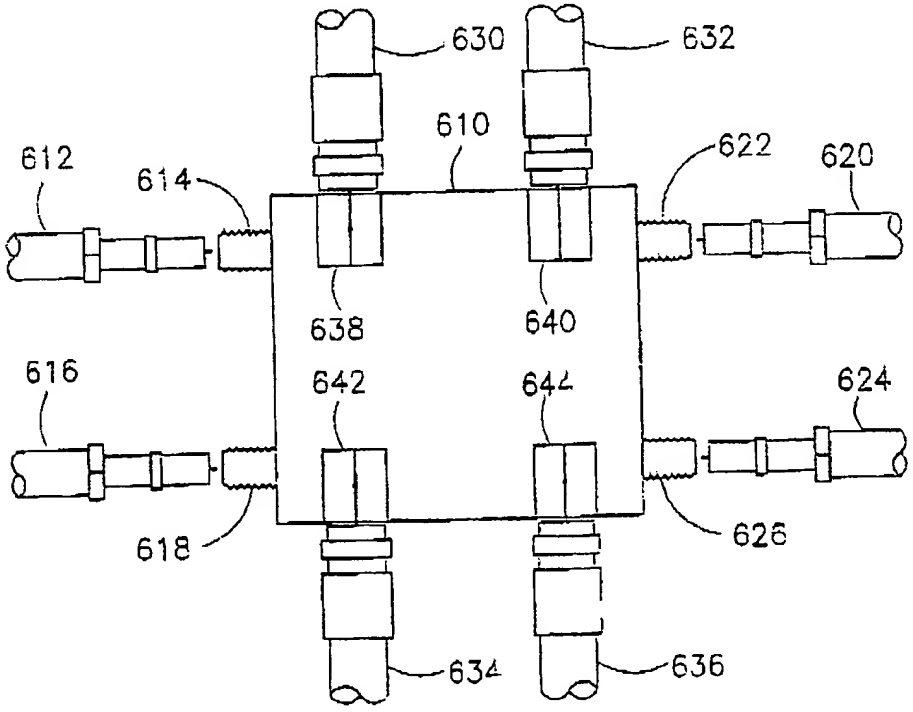
630
632
610
612
614
622
620
638
640
616
642
644
624
618
626
634
636

FIG.27

INTERNATIONAL SEARCH REPORT

International Application No
PCT/IL 01/00181

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H04N7/10 H04N7/173

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 H04N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 774 458 A (WILLIAMSON LOUIS D) 30 June 1998 (1998-06-30)	1,2,4,5, 13-16, 18,20, 32, 37-41,46
Y	column 1, line 36 - line 65; figure 6	6,7,33, 34
A	---	28,36,47
Y	US 4 970 722 A (PRESCHUTTI JOSEPH P) 13 November 1990 (1990-11-13)	6,7,33, 34
A	column 7, line 4 - line 49; figure 2	1,32
A	--- US 5 963 844 A (DAIL JAMES E) 5 October 1999 (1999-10-05) the whole document	1,28,32, 36-39,47

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
4 October 2001	11/10/2001

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Beaudoin, O

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/IL 01/00181

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5774458 A	30-06-1998	NONE	
US 4970722 A	13-11-1990	CA 1300239 A1	05-05-1992
		EP 0339078 A1	02-11-1989
		JP 2502061 T	05-07-1990
		WO 8904567 A1	18-05-1989
		US 4947386 A	07-08-1990
US 5963844 A	05-10-1999	CA 2205248 A1	18-03-1998